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Hosokawa et al.

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(45) **Date of Patent: Aug. 23, 2016**

(54) **POWDER CONTAINER AND IMAGE FORMING APPARATUS**

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(73) Assignee: **RICOH COMPANY, LIMITED**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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§ 371 (c)(1),
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PCT Pub. Date: **Sep. 18, 2014**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G03G 15/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/0843*** (2013.01); ***G03G 15/0884*** (2013.01); *G03G 15/0865* (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC G03G 15/0843; G03G 15/0884; G03G 2215/069
USPC 399/106, 262
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,495,323 A 2/1996 Meetze, Jr.
5,613,177 A 3/1997 Meetze, Jr. et al.
(Continued)

FOREIGN PATENT DOCUMENTS

EP 1 193 570 A2 4/2002
JP 5-46023 2/1993
(Continued)

OTHER PUBLICATIONS

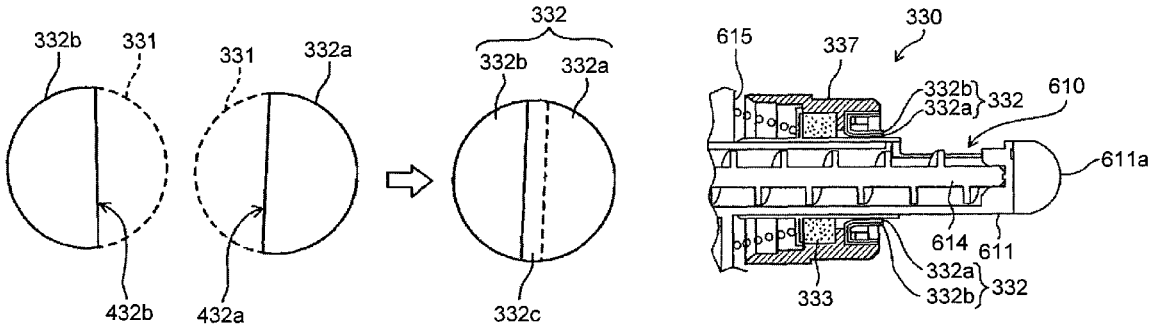
International Search Report issued Jun. 17, 2014 in PCT/JP2014/057941 filed Mar. 14, 2014.
(Continued)

Primary Examiner — Benjamin Schmitt
(74) *Attorney, Agent, or Firm* — Oblon, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

A toner container which is a powder container includes a container body that stores toner which is powder; a nozzle receiver having a nozzle insertion opening which is a nozzle insertion opening through which a powder conveying nozzle of a powder conveying device is inserted in the container body; and an elastic sheet which is an elastic sheet member that blocks the nozzle insertion opening and is elastically deformed so that the powder conveying nozzle can pass through when the powder conveying nozzle is inserted. A plurality of elastic sheets is arranged so as to overlap at least partially.

18 Claims, 28 Drawing Sheets



(52) **U.S. Cl.**
CPC *G03G15/0872* (2013.01); *G03G 2215/0132* (2013.01); *G03G 2215/069* (2013.01); *G03G 2215/0678* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2001/0021326	A1	9/2001	Yanagisawa et al.	
2002/0106215	A1	8/2002	Ban et al.	
2002/0114646	A1	8/2002	Sudo et al.	
2002/0122104	A1*	9/2002	Hatasa	B41J 2/17523 347/86
2003/0116923	A1	6/2003	Meetze, Jr. et al.	
2003/0170049	A1	9/2003	Itoh et al.	
2004/0197119	A1*	10/2004	Matsumoto	G03G 15/0898 399/258
2004/0223790	A1	11/2004	Hosokawa et al.	
2006/0193659	A1	8/2006	Tanda	
2007/0077100	A1	4/2007	Suzuki et al.	
2008/0286013	A1	11/2008	Hosokawa et al.	
2009/0175660	A1	7/2009	Hosokawa et al.	
2012/0099902	A1	4/2012	Yoshida et al.	
2012/0213555	A1*	8/2012	Komatsu	G03G 15/087 399/262
2013/0272750	A1	10/2013	Matsumoto et al.	

FOREIGN PATENT DOCUMENTS

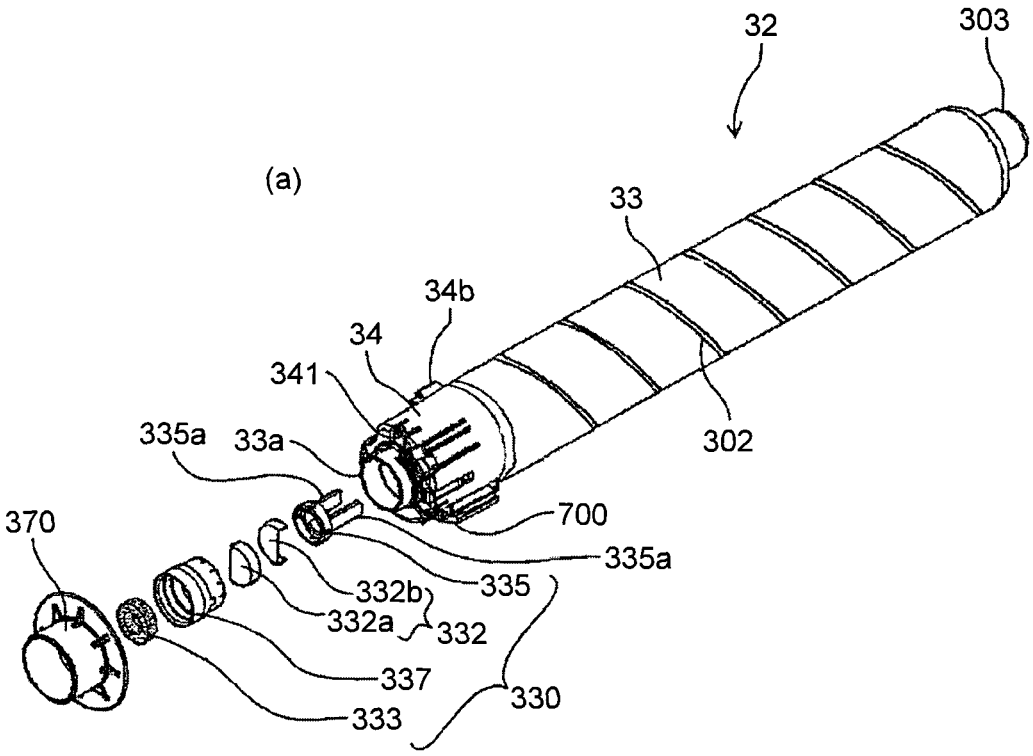
JP	6-329102	11/1994
JP	7-261492	10/1995
JP	9-197818	7/1997
JP	2001-201926	7/2001
JP	2002-202656	7/2002
JP	2003-195616	7/2003
JP	2003-233247	8/2003
JP	2003-241496	8/2003
JP	2004-198765	7/2004
JP	2005-221825	8/2005
JP	2009-175521	8/2009
JP	4342958	10/2009
JP	2009-276659	11/2009
JP	4441581	3/2010

OTHER PUBLICATIONS

Extended European Search Report issued Feb. 5, 2016 in Patent Application No. 14763610.4.

* cited by examiner

FIG.1


(a)
32
303
33
34b
34
341
335a
33a
302
370
700
335a
335
332b
332a
332
337
330
333

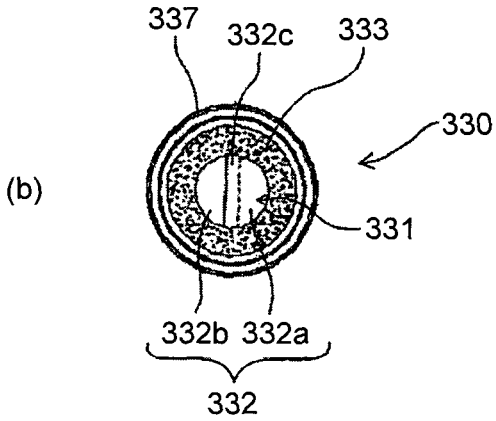

(b)
337
332c
333
330
331
332b
332a
332

FIG.2

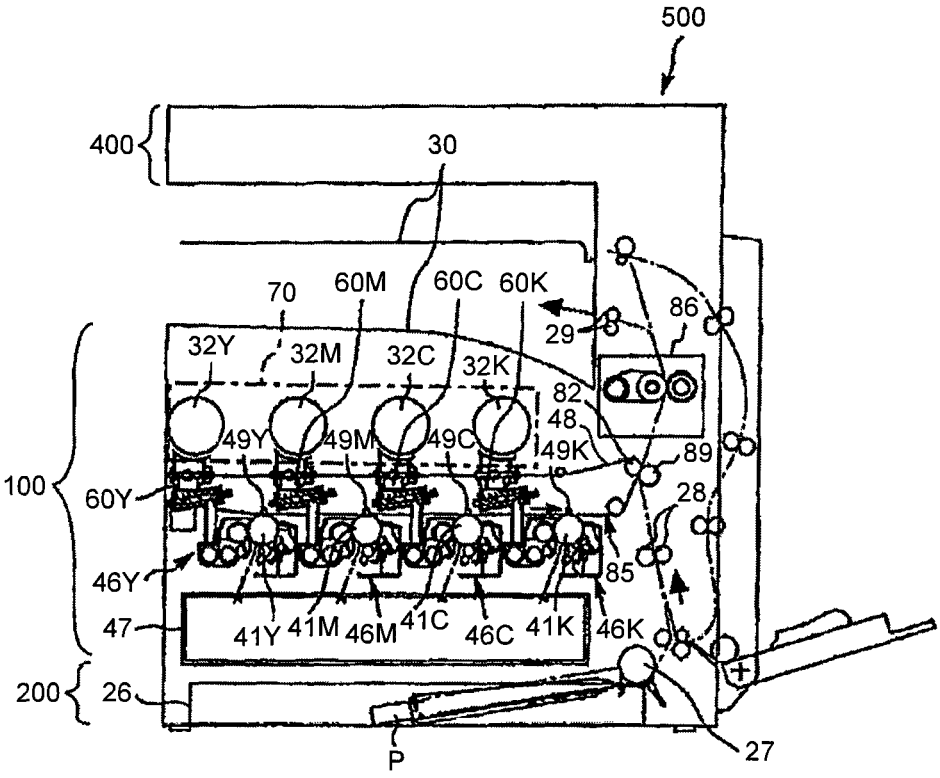

500
400
30
70
60M
60C
60K
86
29
32Y
32M
32C
32K
82
48
49Y
49M
49C
49K
89
100
60Y
28
46Y
85
47
41Y
41M
46M
41C
46C
41K
46K
200
26
P
27

FIG.3

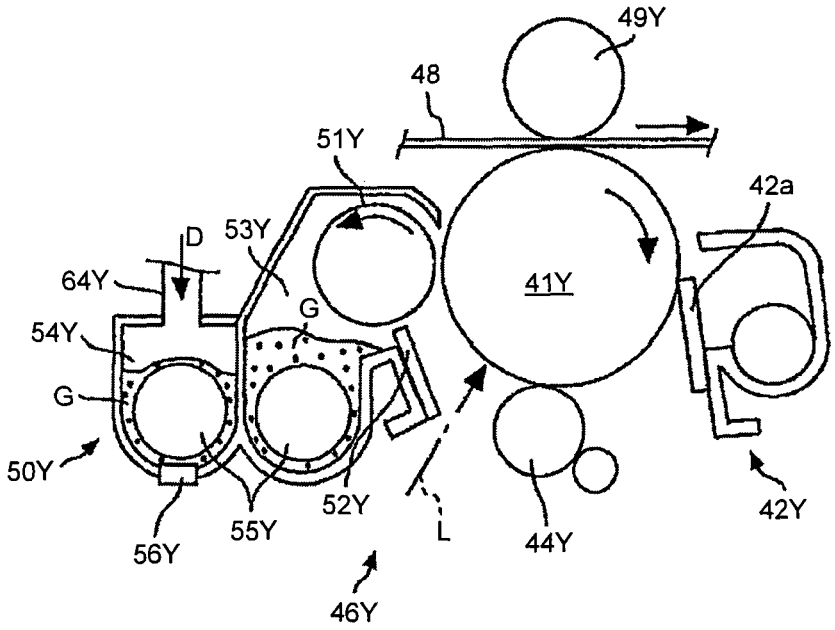

49Y
48
51Y
42a
D
53Y
64Y
41Y
G
54Y
G
50Y
52Y
L
44Y
42Y
56Y
55Y
46Y

FIG.4

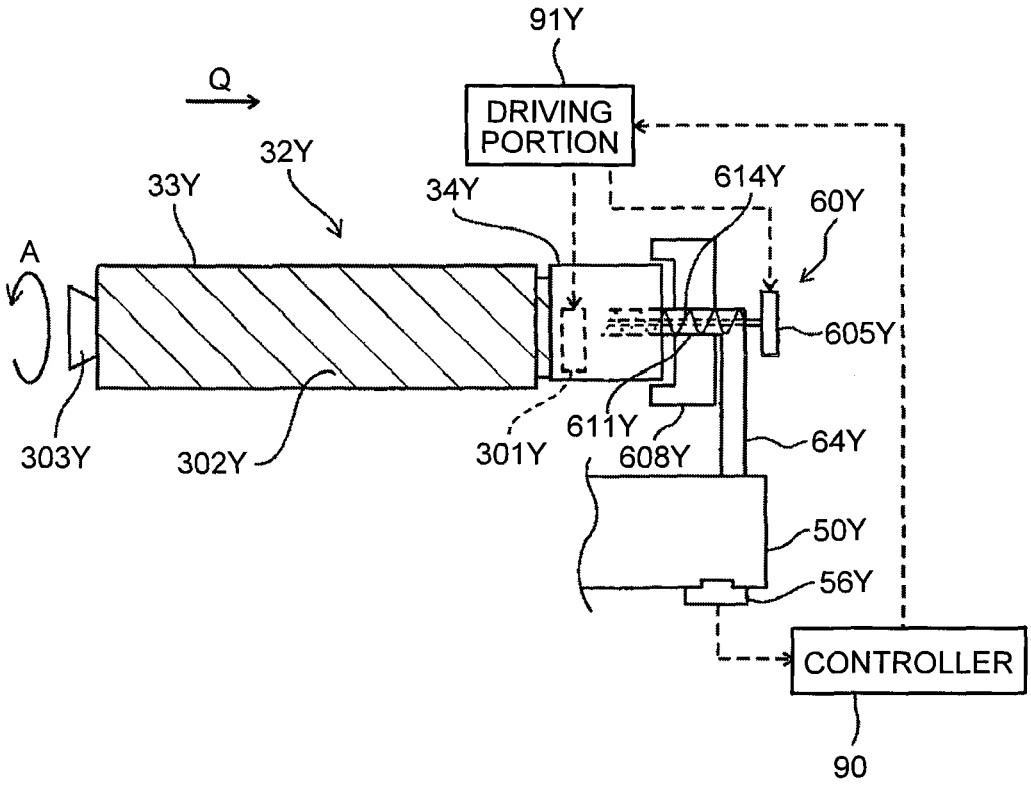

91Y
Q
DRIVING PORTION
32Y
33Y
34Y
614Y
60Y
A
605Y
303Y
302Y
301Y
611Y
608Y
64Y
50Y
56Y
CONTROLLER
90

FIG.5

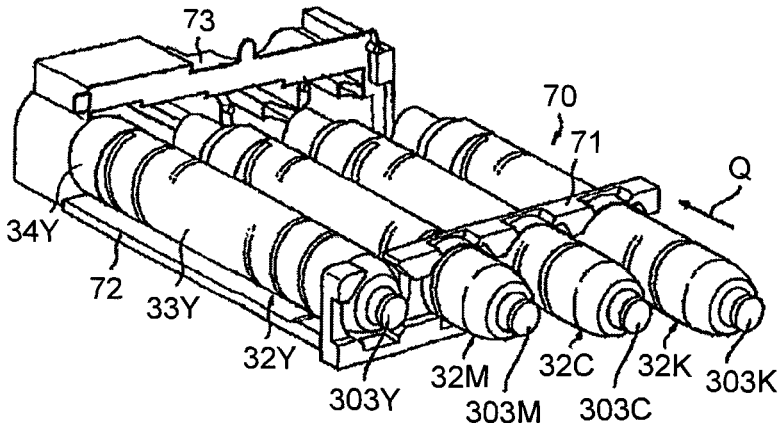

73
70
71
Q
34Y
72
33Y
32Y
303Y
32M
303M
32C
303C
32K
303K

FIG.6

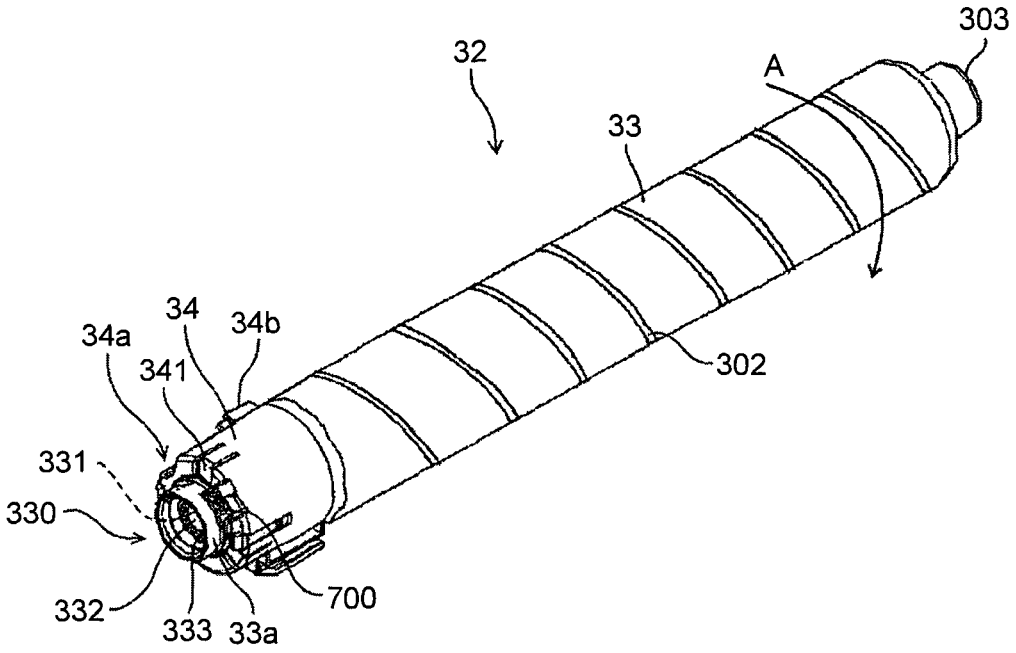

303
32
A
33
34
34b
34a
341
331
330
302
332
333
33a
700

FIG.7

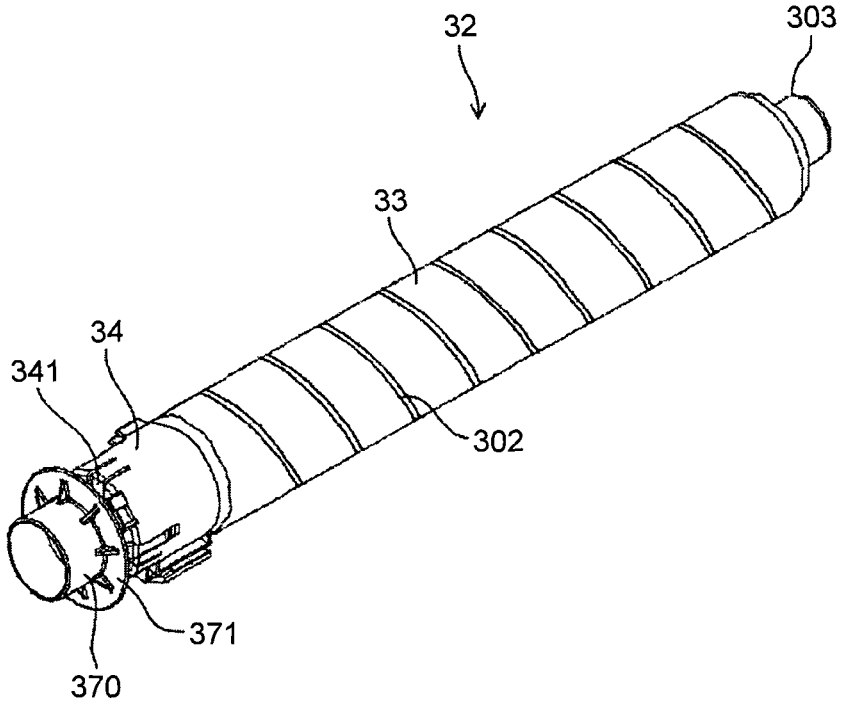

32
303
33
34
341
302
371
370

FIG.8

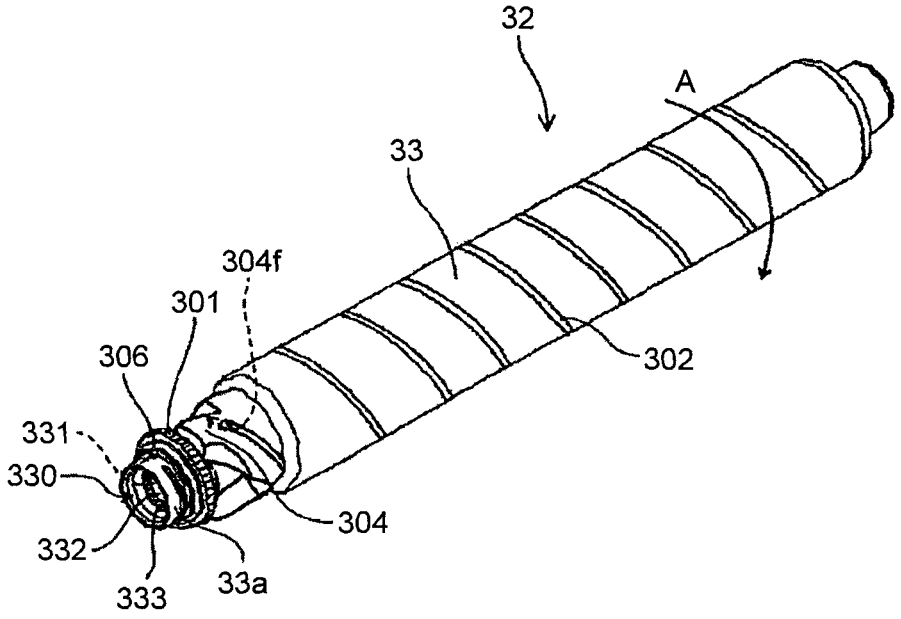

32
A
33
304f
301
306
302
331
330
304
332
33a
333

FIG.9

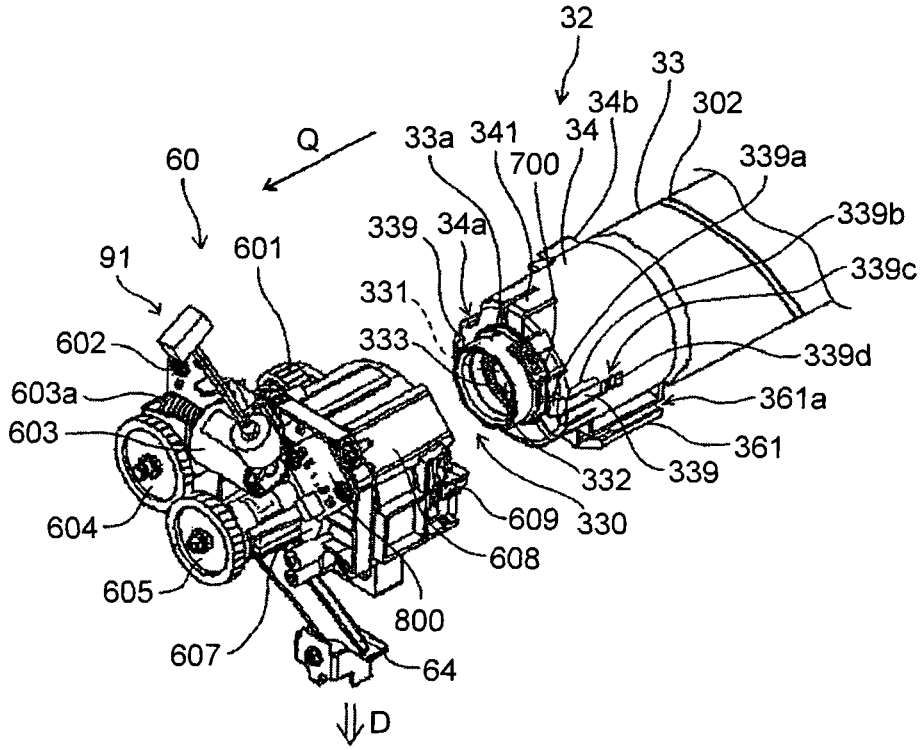

32
33
34b
302
Q
33a
341
34
339a
60
700
339b
339
34a
601
91
339c
331
602
333
339d
603a
361a
603
361
339
332
609
330
604
608
605
800
607
64
D

FIG.10

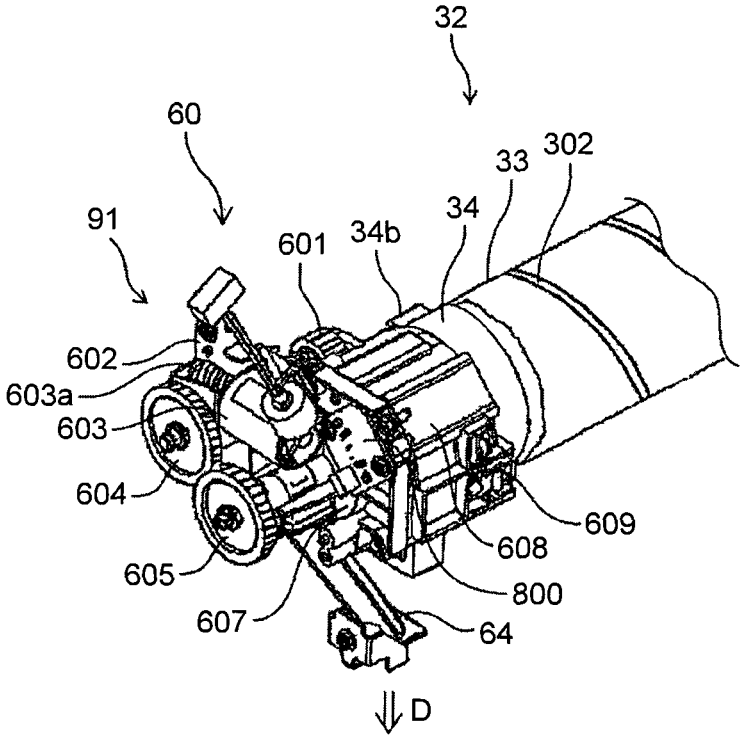

32
60
33
302
91
34
601
34b
602
603a
603
604
609
608
605
800
607
64
D

FIG.11

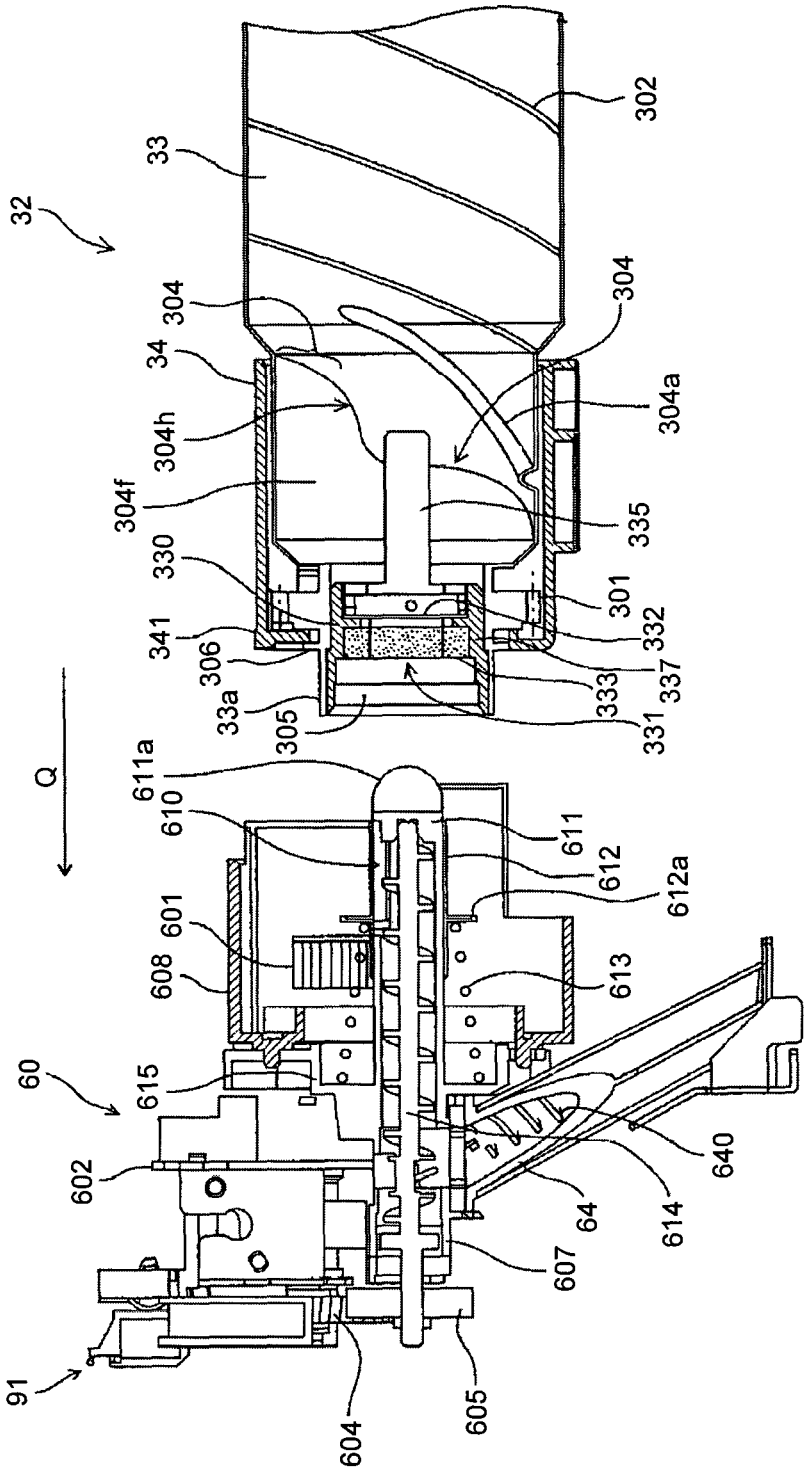

32
33
302
304
34
304h
304f
304a
335
330
301
341
306
332
337
33a
305
333
331
611a
610
611
612
612a
601
608
613
60
615
640
602
64
614
607
91
604
605
Q

FIG.12

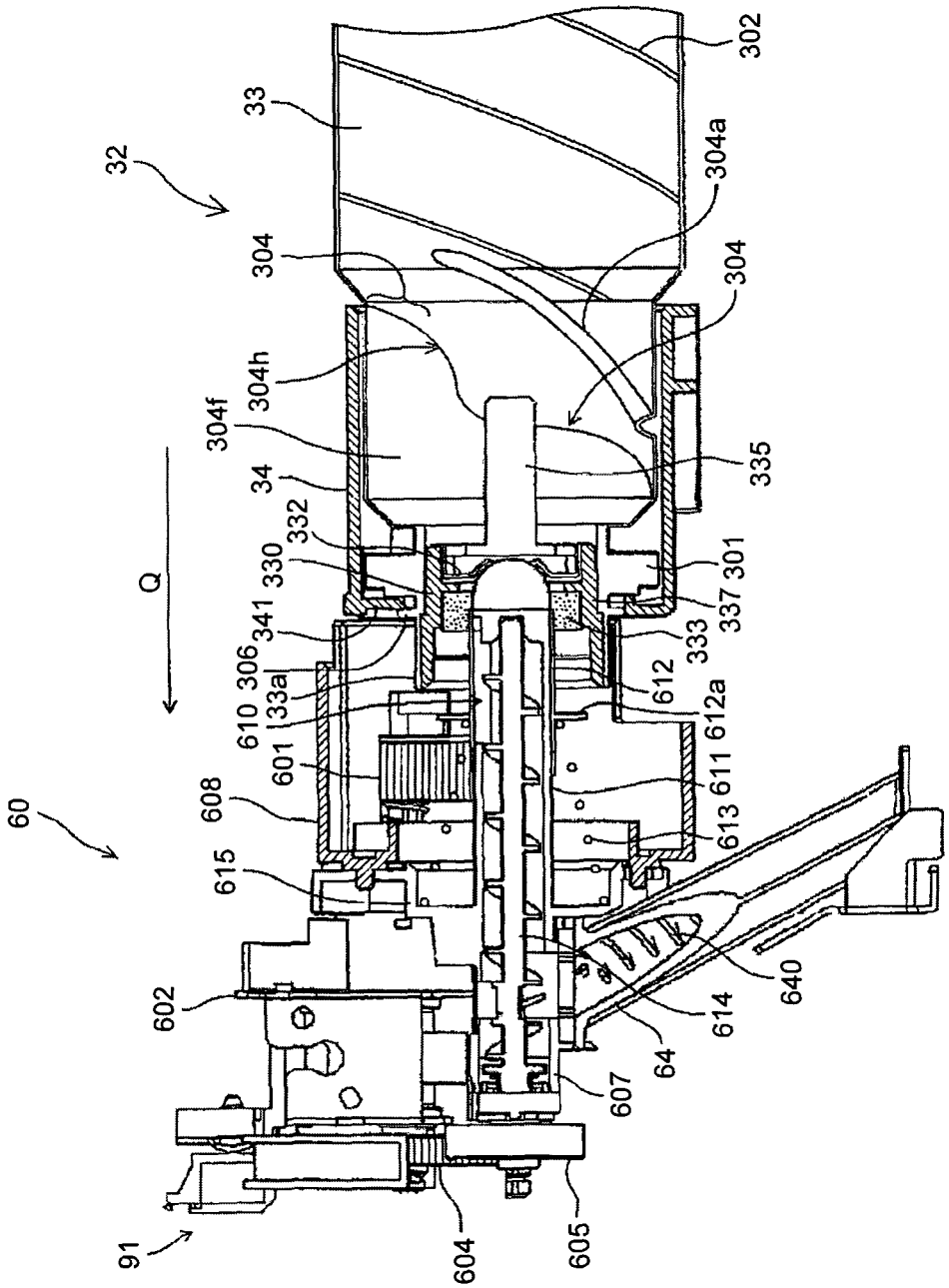

302
33
32
304a
304
304
304h
304f
335
34
332
330
301
337
341
333
306
612
610
133a
612a
601
611
608
613
615
640
602
614
64
607
91
604
605
Q
60

FIG.13

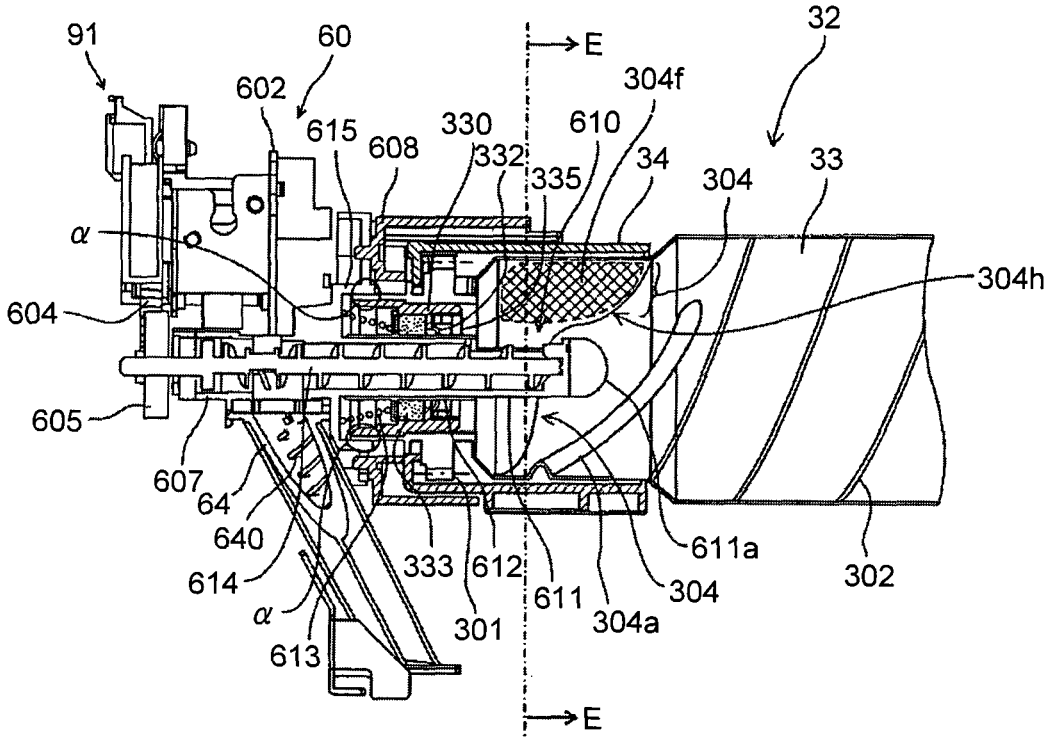

91
60
602
615
608
330
332
335
610
304f
34
304
33
32
E
α
604
304h
605
607
64
640
614
α
613
333
612
611
304a
301
304
611a
302
E

FIG.14

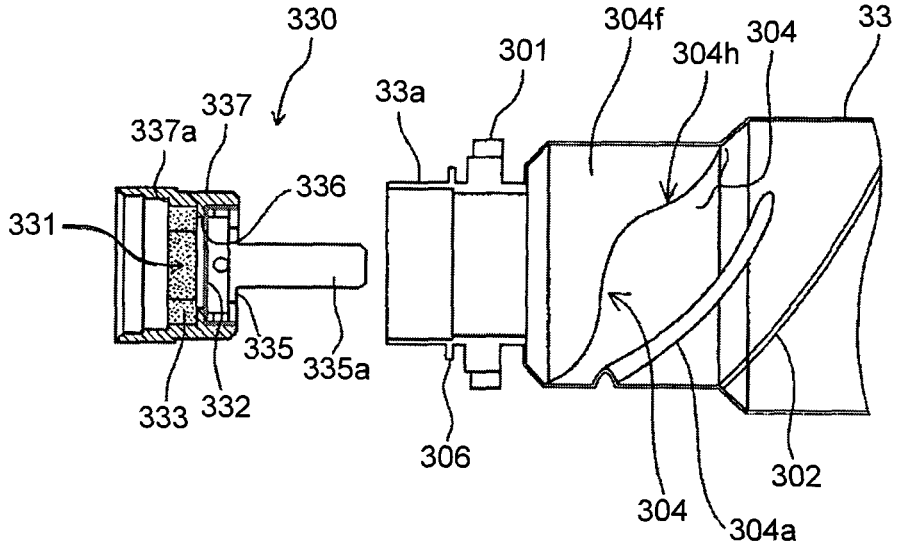

330
337
337a
336
331
335
335a
333
332
306
301
33a
304f
304h
304
33
302
304
304a

FIG.15

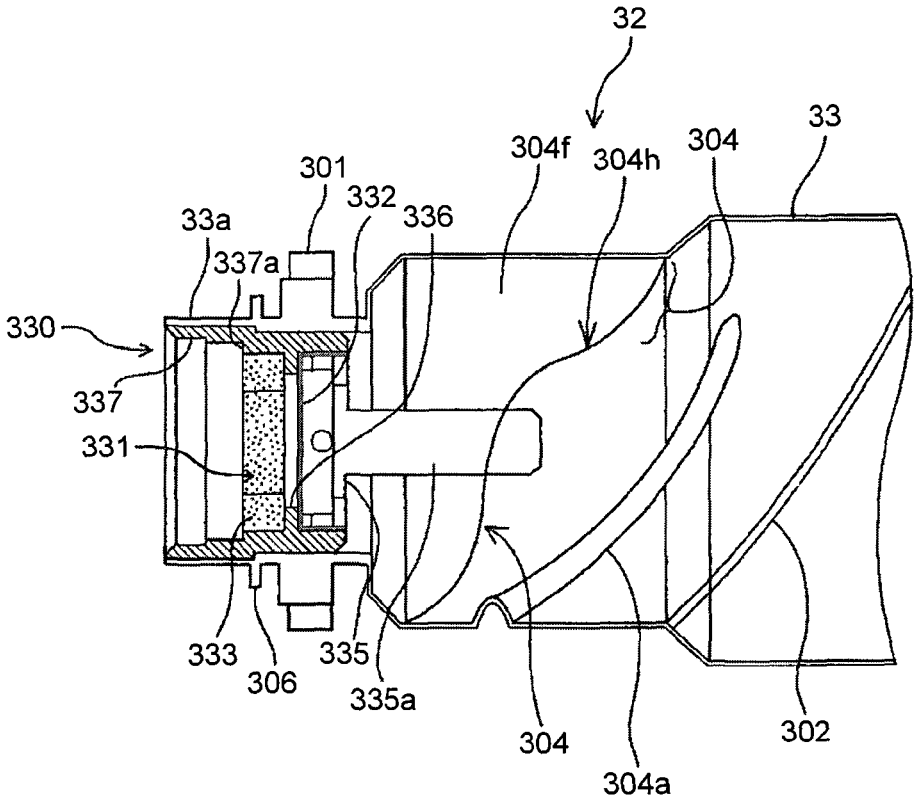

32
33
304f
304h
304
301
332
336
33a
337a
330
337
331
333
306
335
335a
304
304a
302

FIG.16

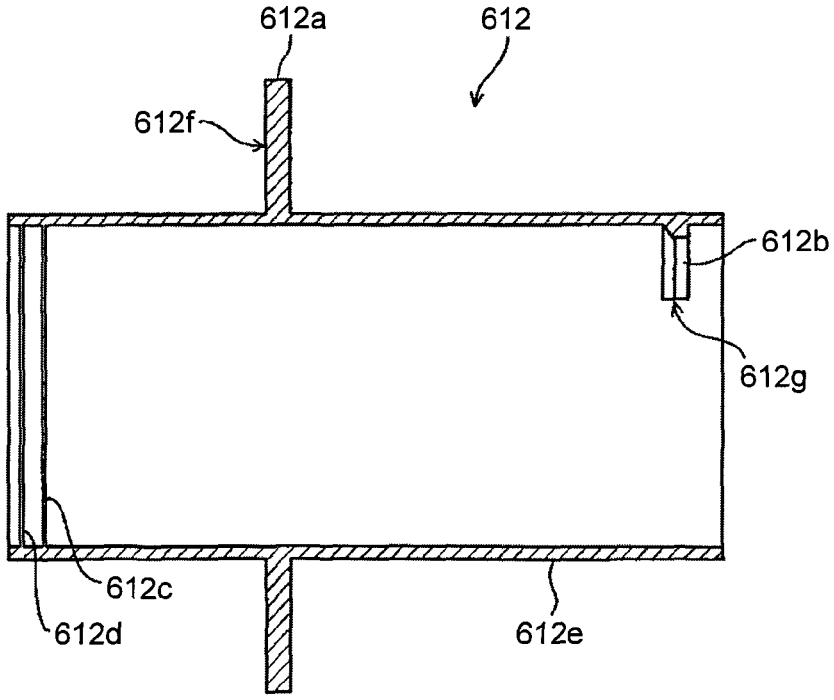

612a
612
612f
612b
612g
612c
612d
612e

FIG.17

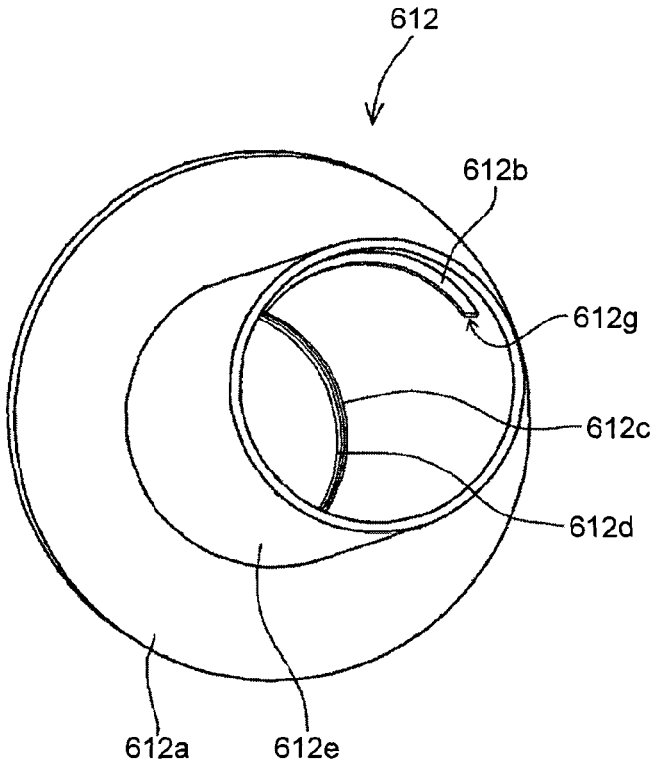

612
612b
612g
612c
612d
612a
612e

FIG.18

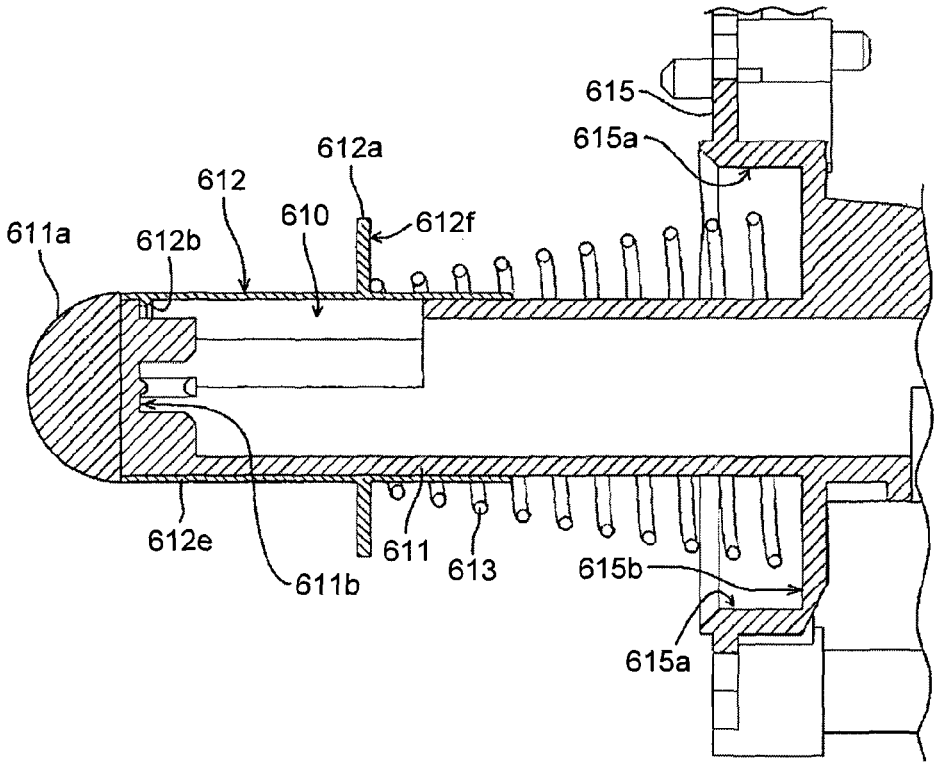

615
615a
612a
612
610
612f
611a
612b
612e
611b
611
613
615b
615a

FIG.19

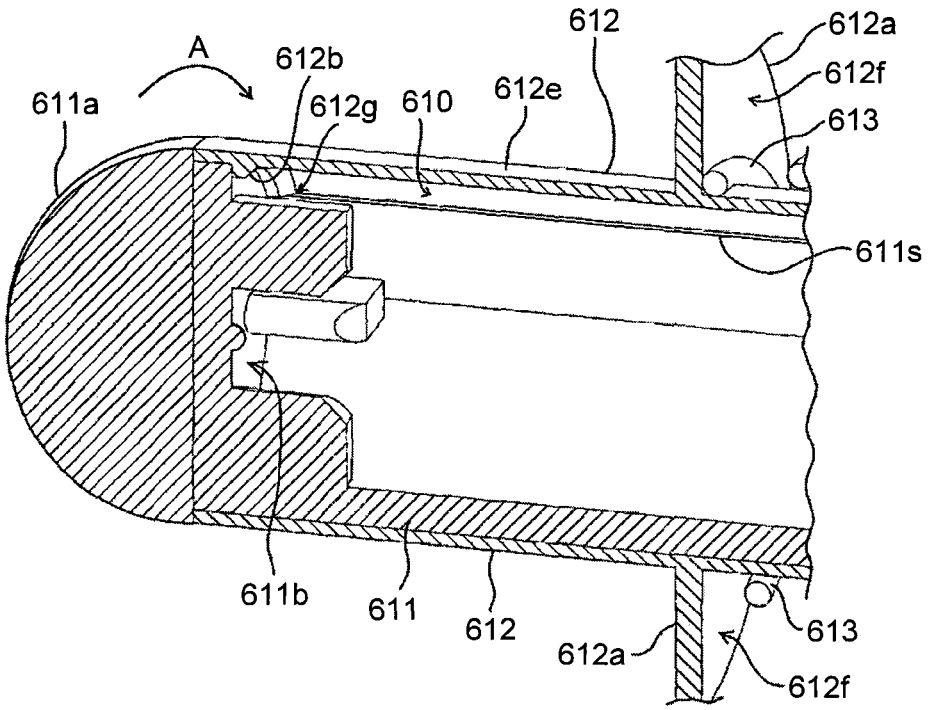

A
611a
612b
612g
610
612e
612
612a
612f
613
611s
611b
611
612
612a
613
612f

FIG.20

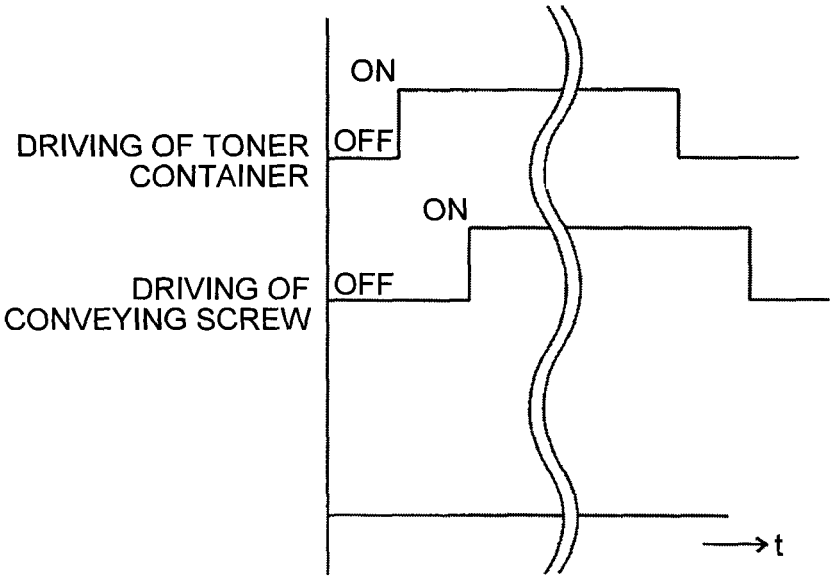

ON
DRIVING OF TONER CONTAINER
OFF
ON
DRIVING OF CONVEYING SCREW
OFF
t

FIG.21

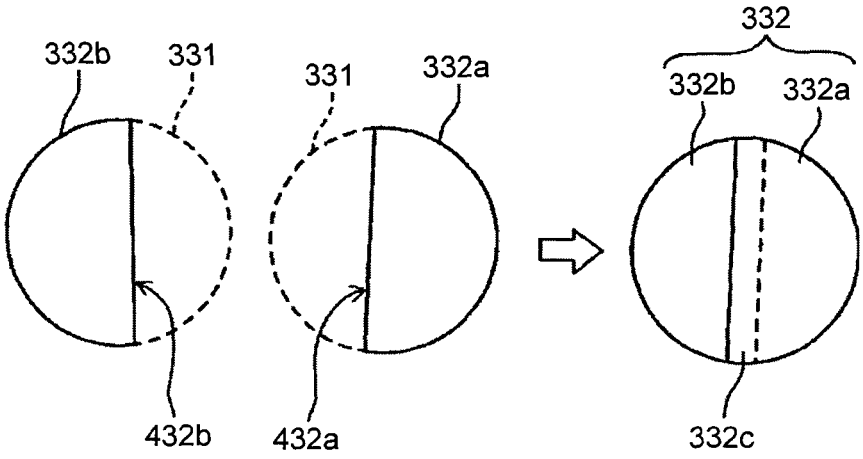


FIG.22

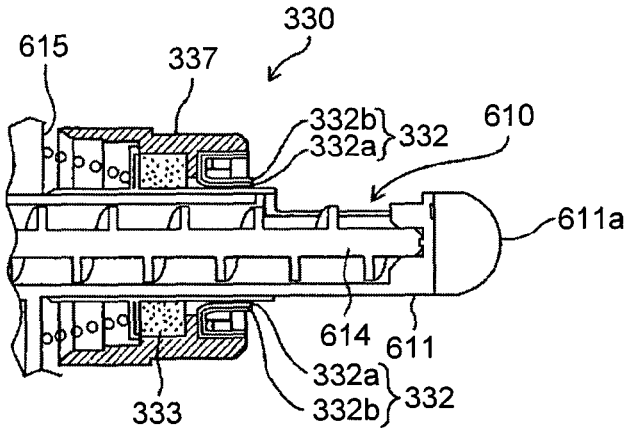


FIG.23

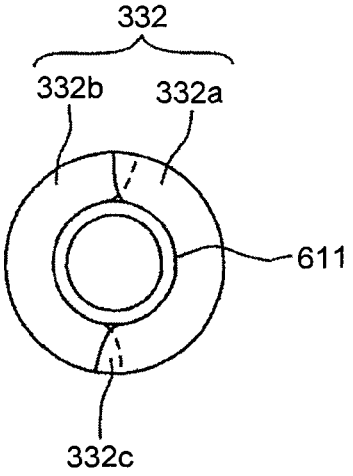


FIG.24

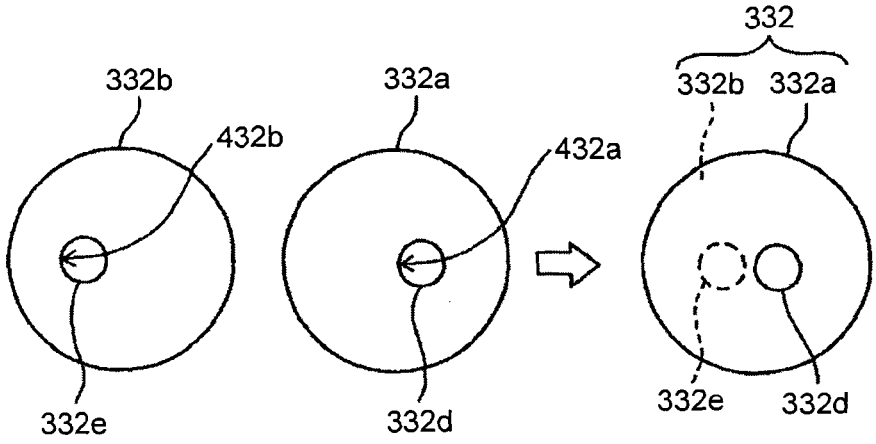


FIG.25

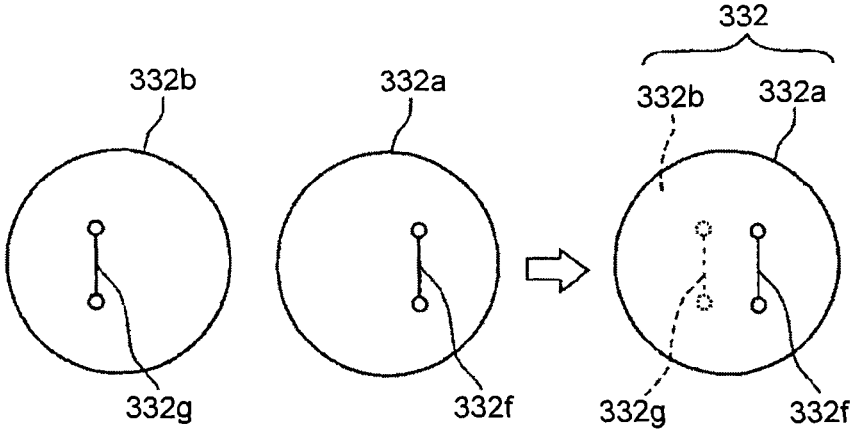


FIG.26

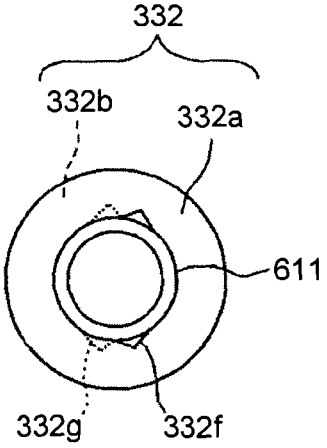


FIG.27

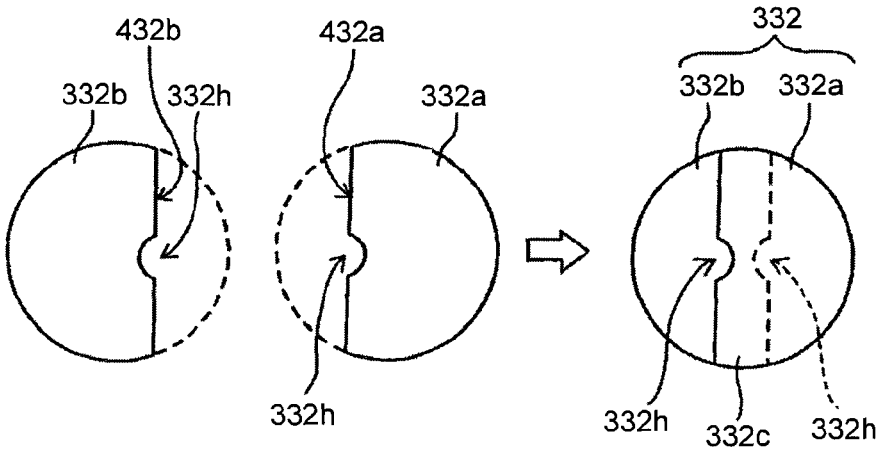

432b
332b
332h
432a
332a
332h
332
332b
332a
332h
332c
332h

FIG.28

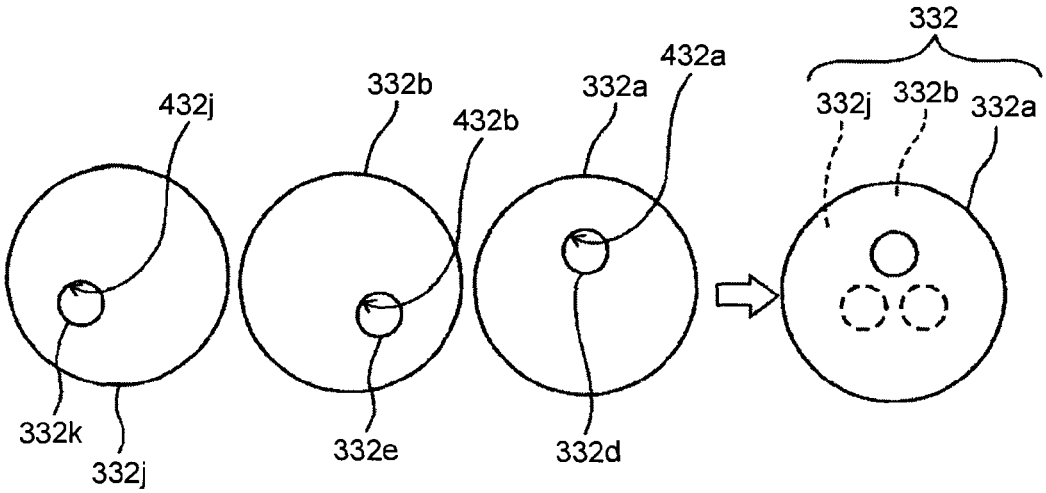

432j
332k
332j
332b
432b
332e
332a
432a
332d
332
332j
332b
332a

FIG.29

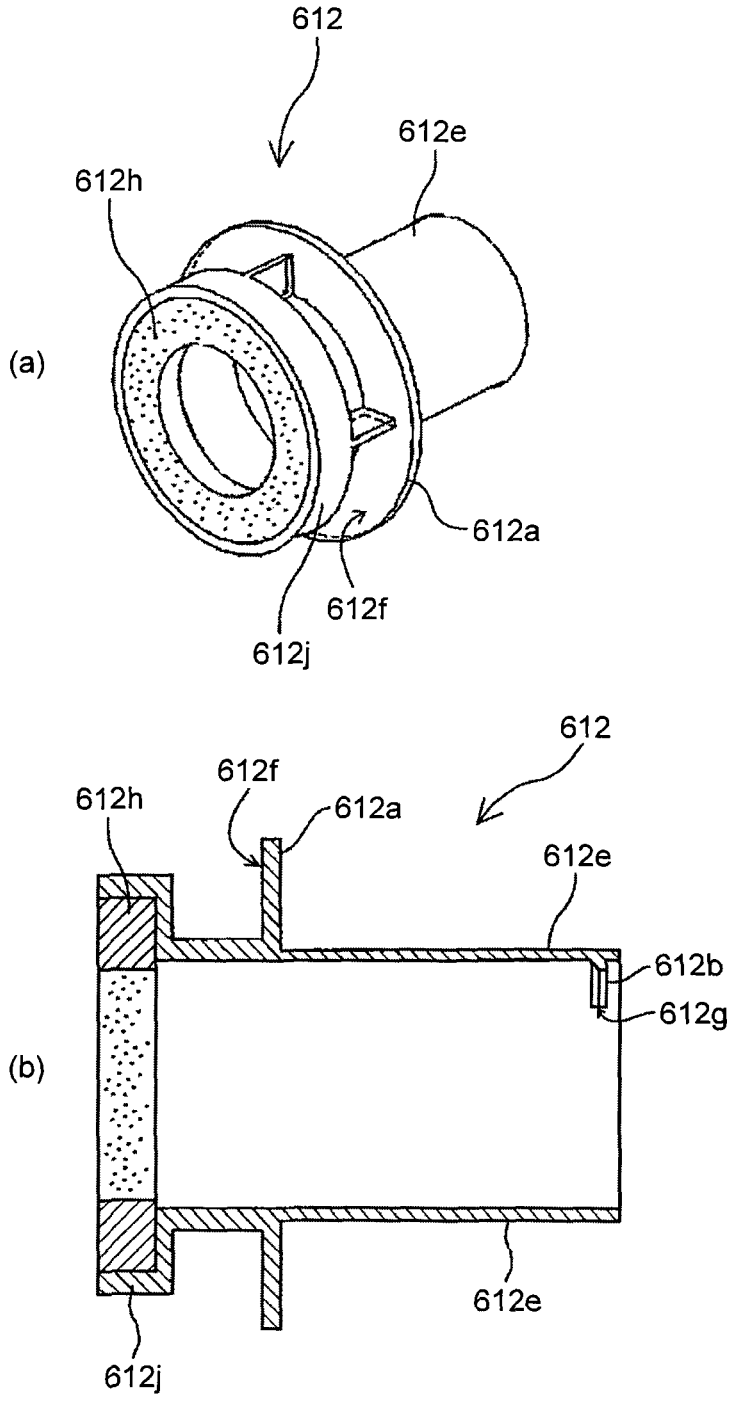

(a)
612
612e
612h
612a
612f
612j
(b)
612
612f
612h
612a
612e
612b
612g
612e
612j

FIG.30

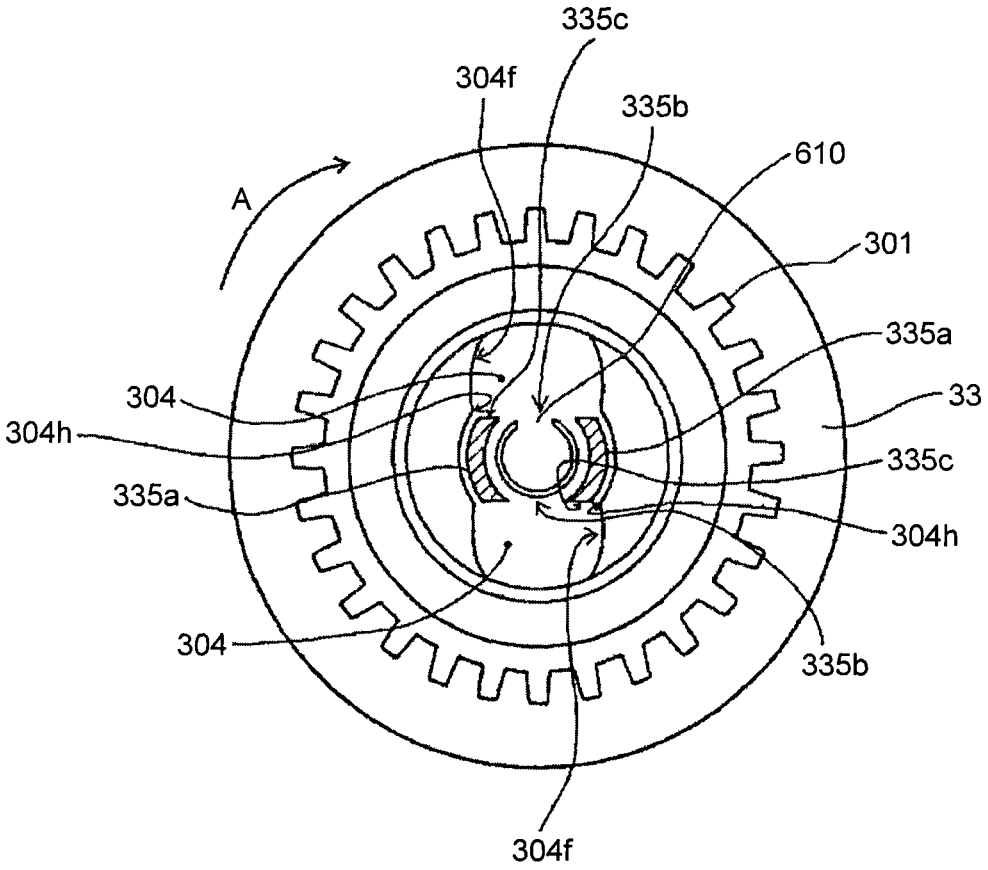

335c
304f
335b
610
A
301
335a
304
33
304h
335c
335a
304h
304
335b
304f

FIG.31

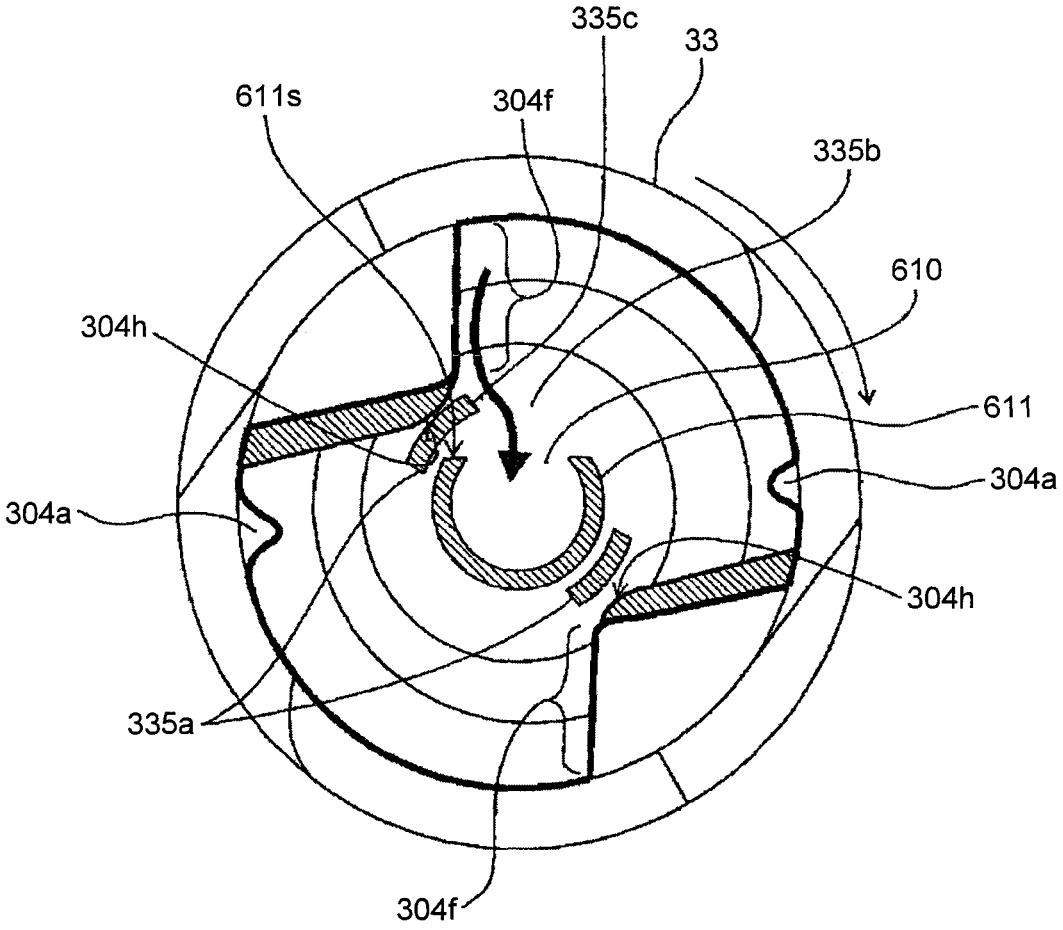


FIG.32

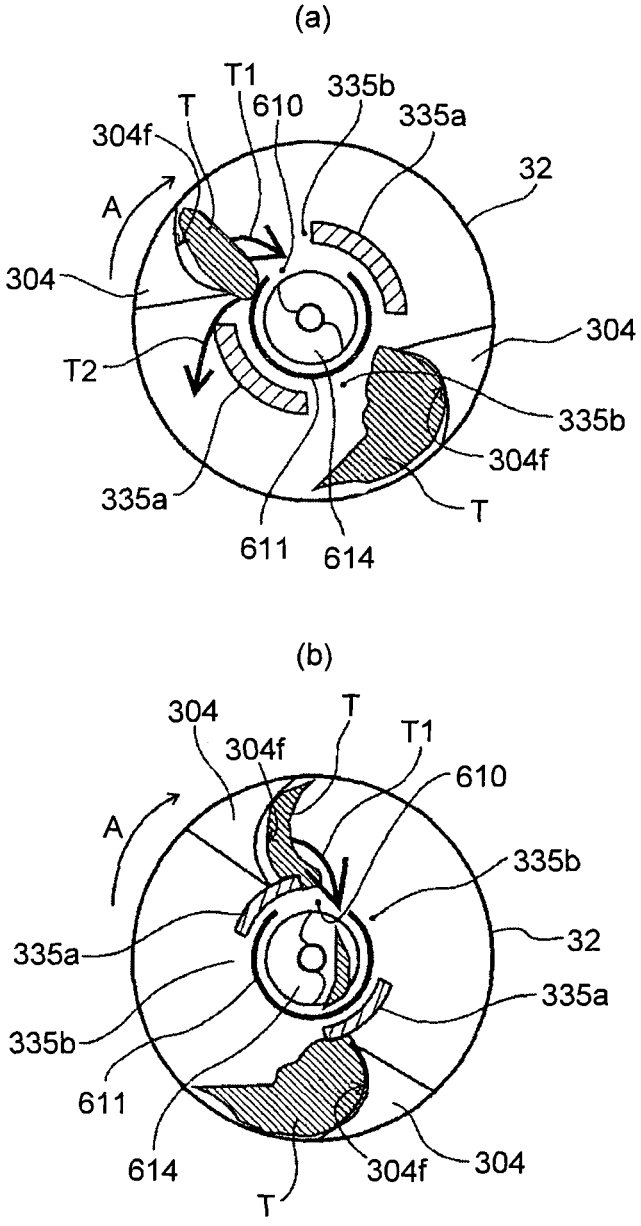

(a)
T1
T
610
335b
335a
304f
32
A
304
304
T2
335b
304f
335a
T
611
614
(b)
304
T
T1
304f
610
A
335b
335a
32
335a
335b
611
614
304f
304
T

FIG.33

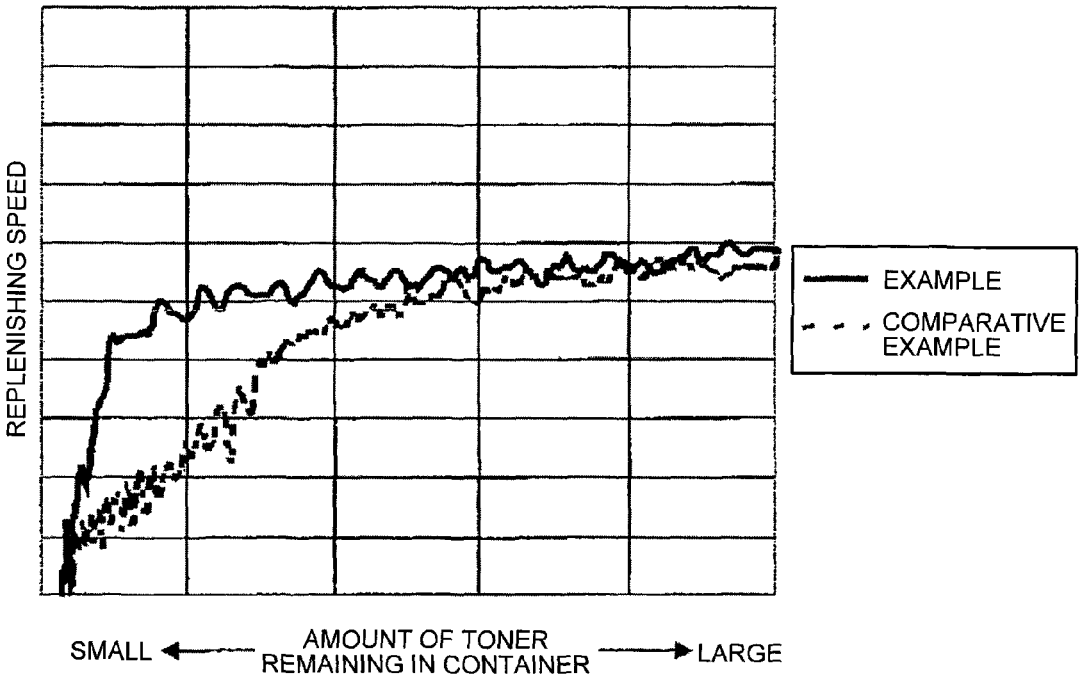
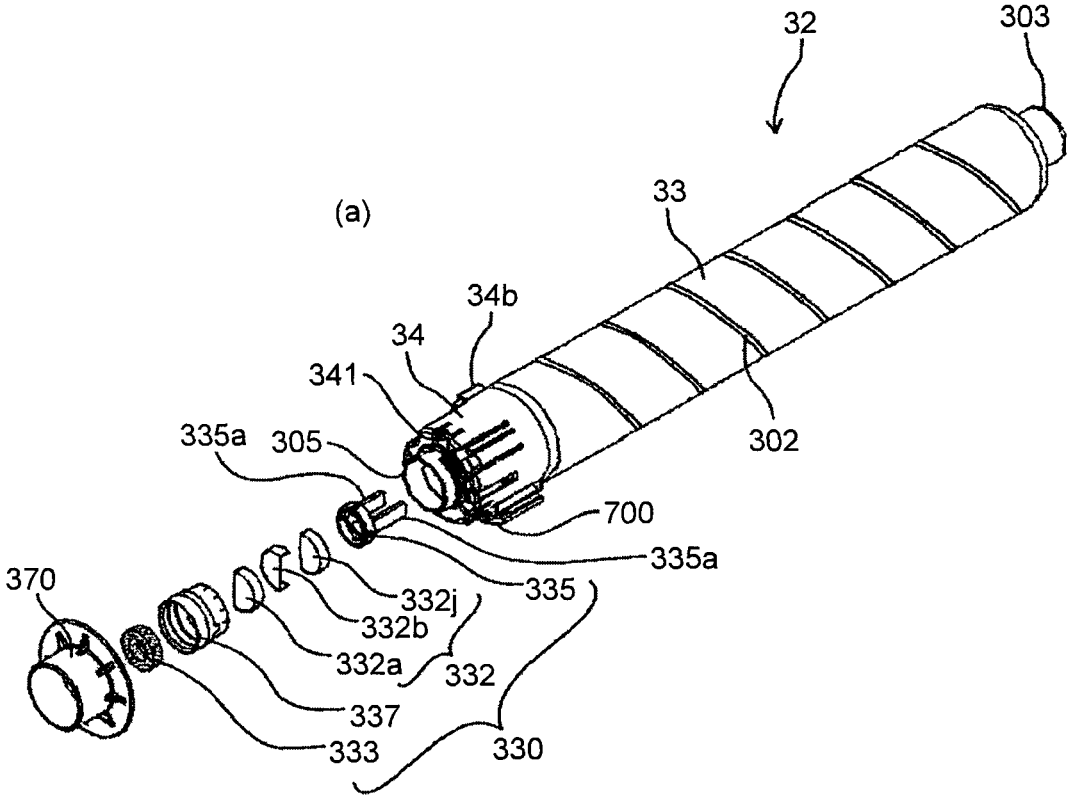

REPLENISHING SPEED
EXAMPLE
COMPARATIVE EXAMPLE
SMALL
AMOUNT OF TONER REMAINING IN CONTAINER
LARGE

FIG.34


32
303
(a)
33
34b
34
341
335a
305
302
700
335a
370
335
332j
332b
332a
332
337
333
330

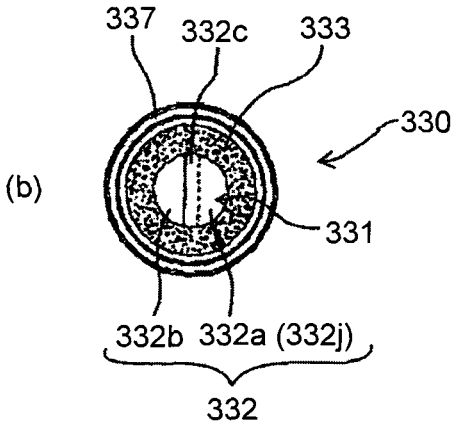

337
332c
333
330
(b)
331
332b
332a (332j)
332

FIG.35

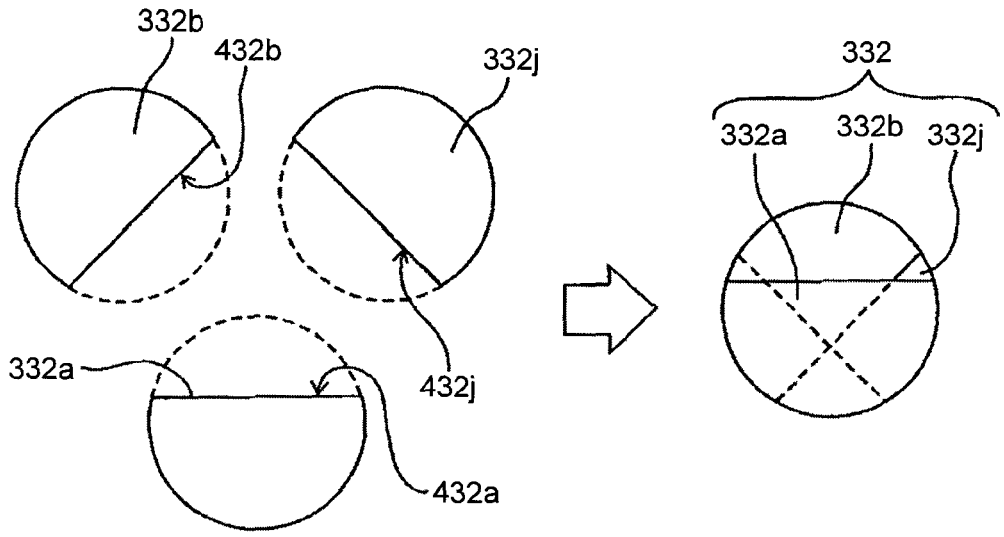

332b
432b
332j
332a
432j
432a
332
332a
332b
332j

FIG.36

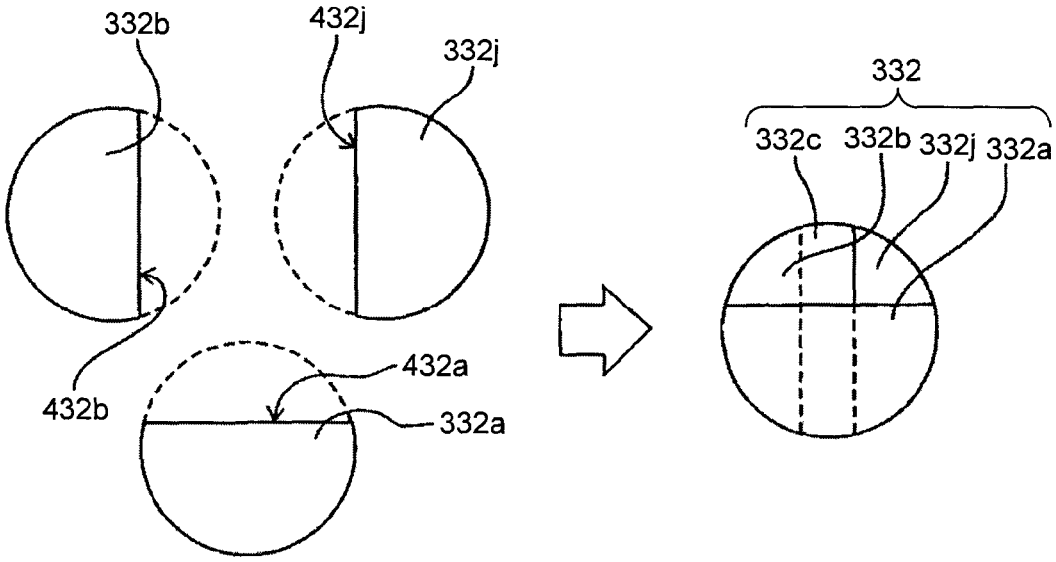

332b
432j
332j
432b
432a
332a
332
332c
332b
332j
332a

FIG.37

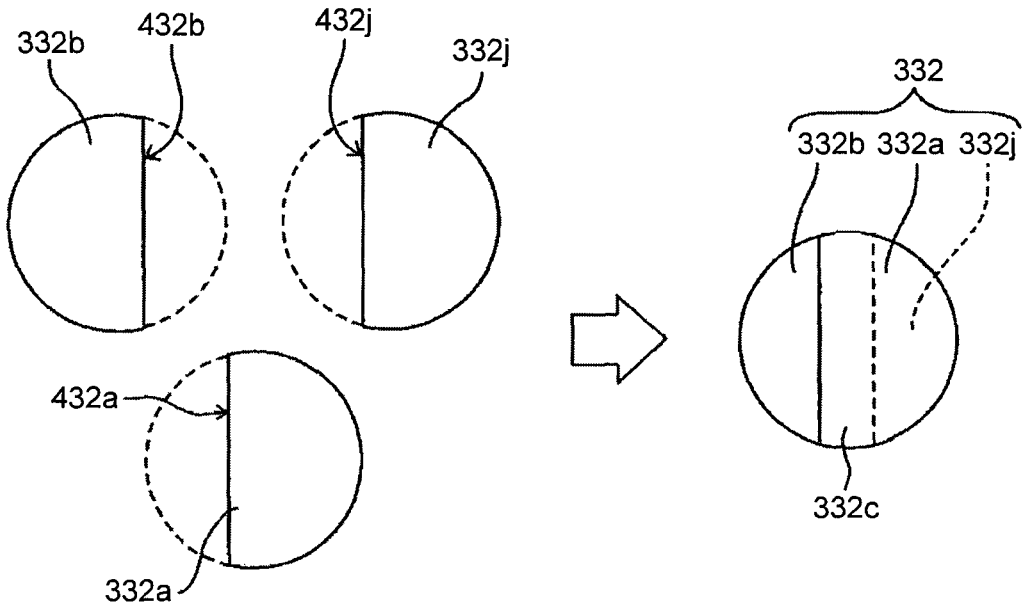

332b
432b
432j
332j
432a
332a
332
332b 332a 332j
332c

FIG.38

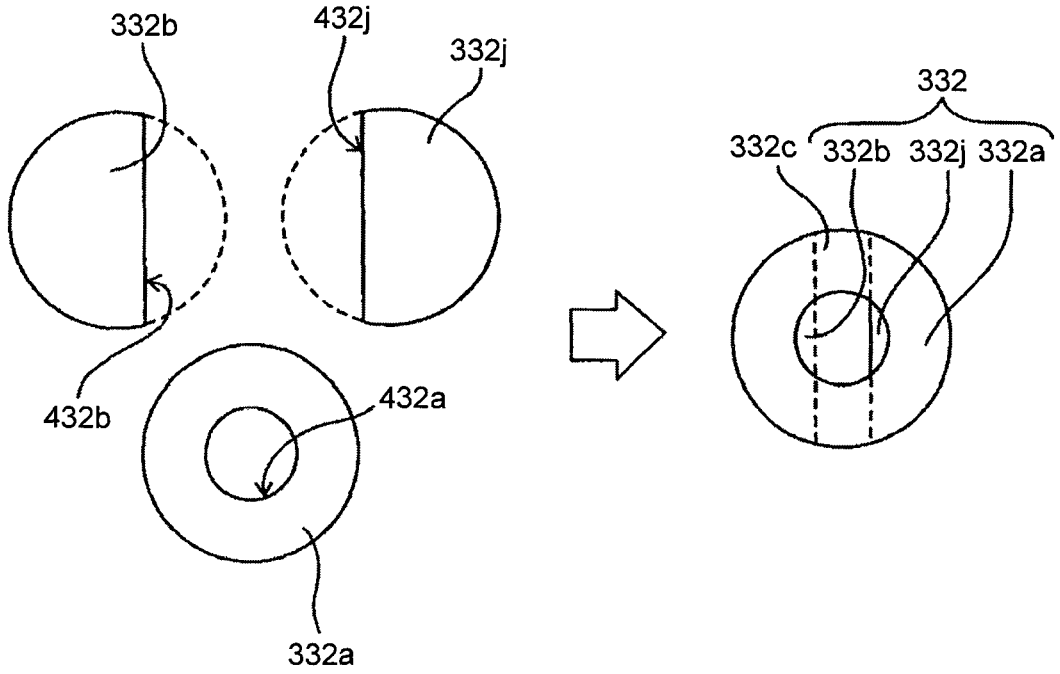

332b
432j
332j
432b
432a
332a
332
332c
332b 332j 332a

FIG.39

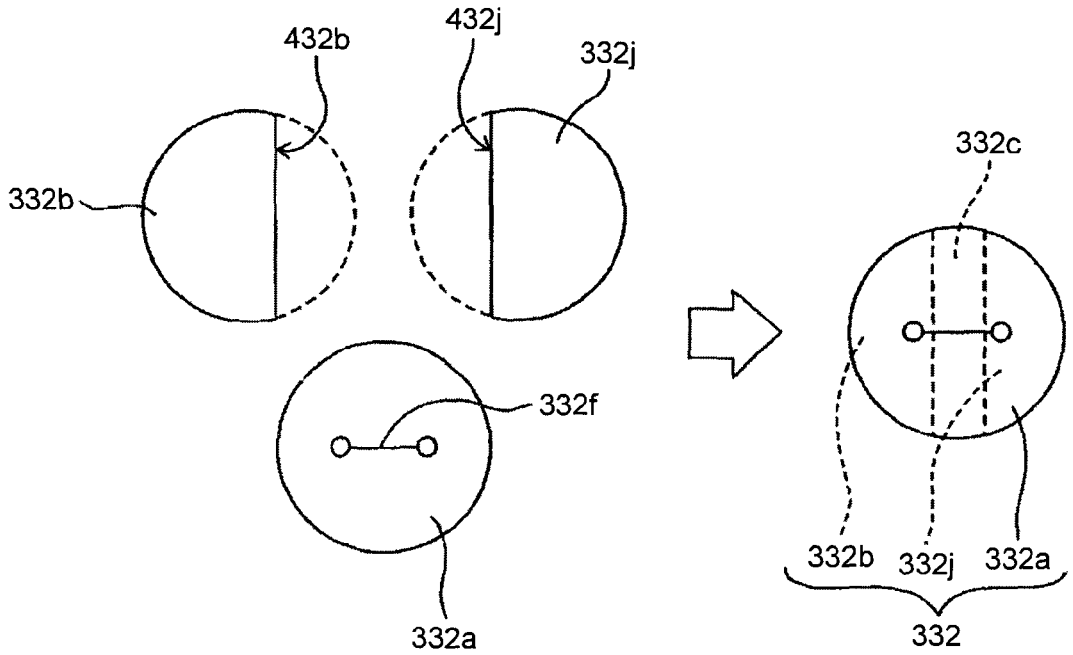

432b
432j
332j
332b
332c
332f
332a
332b
332j
332a
332

FIG.40

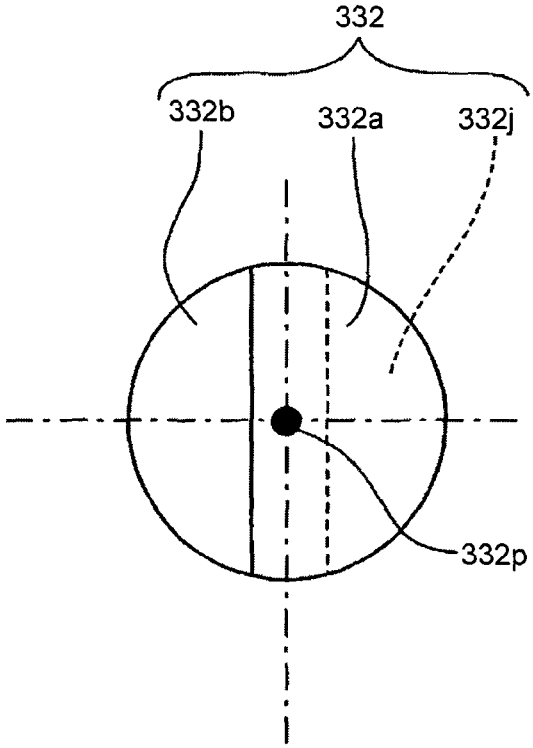

332
332b
332a
332j
332p

FIG.41

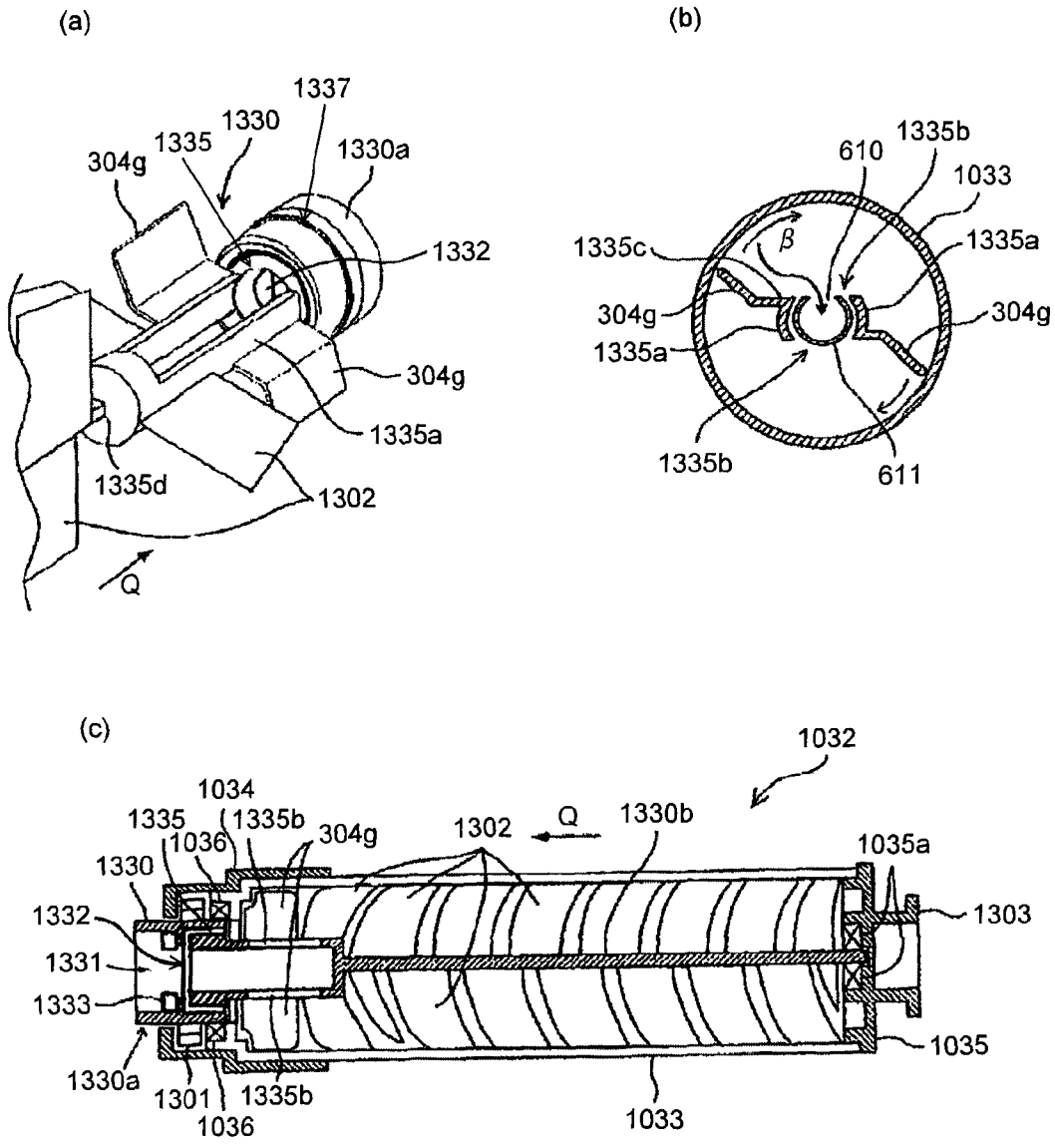

(a)
1337
1330
1335
304g
1330a
1332
304g
1335a
1335d
1302
Q
(b)
1335b
610
1033
1335c
β
1335a
304g
304g
1335a
1335b
611
(c)
1032
1034
1335
1335b
304g
1302
Q
1330b
1035a
1036
1330
1303
1332
1331
1333
1035
1330a
1301
1335b
1036
1033

FIG.42

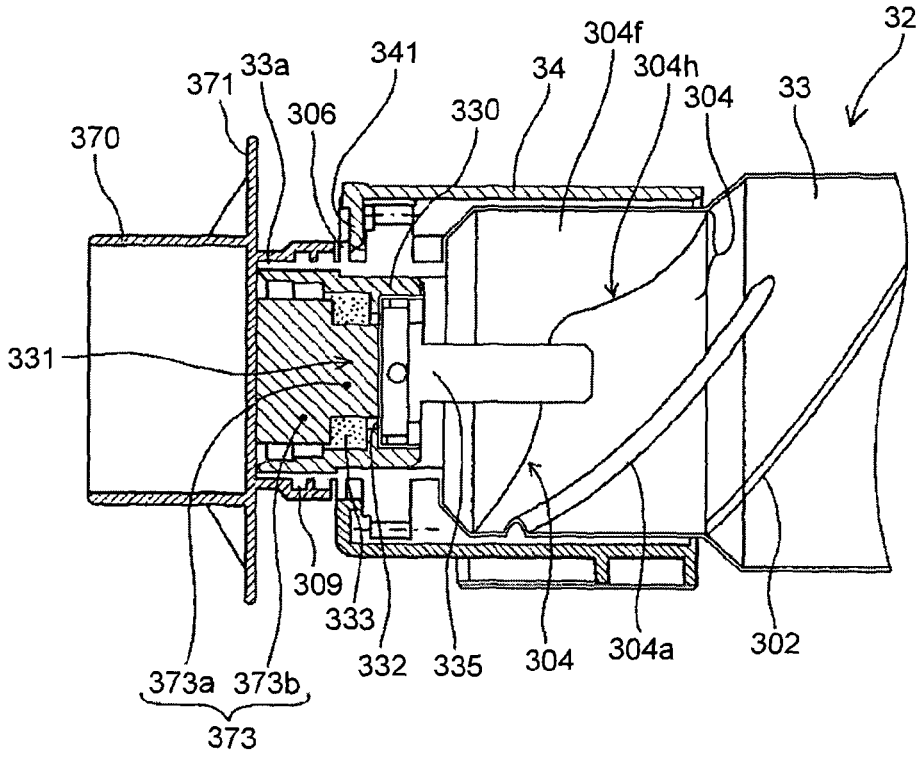

32
304f
341
33a
371
34
304h
306
330
304
33
370
331
309
333
332
335
304
304a
302
373a
373b
373

FIG.43

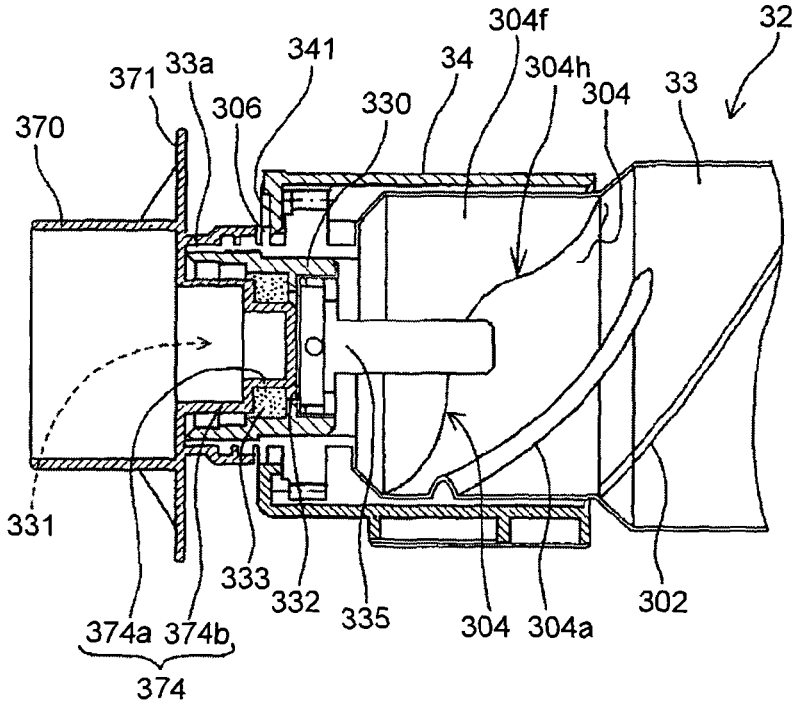

304f
32
341
33a
371
34
304h
306
330
304
33
370
331
333
332
335
304
304a
302
374a
374b
374

FIG.44

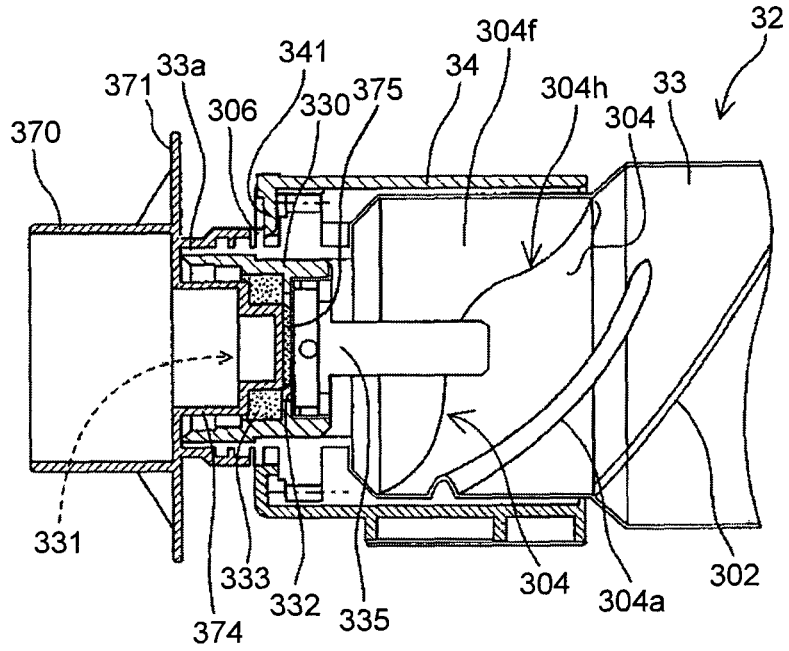

32
304f
341
33a
34
371
375
304h
33
306
330
304
370
331
333
332
335
304
304a
302
374

FIG.45

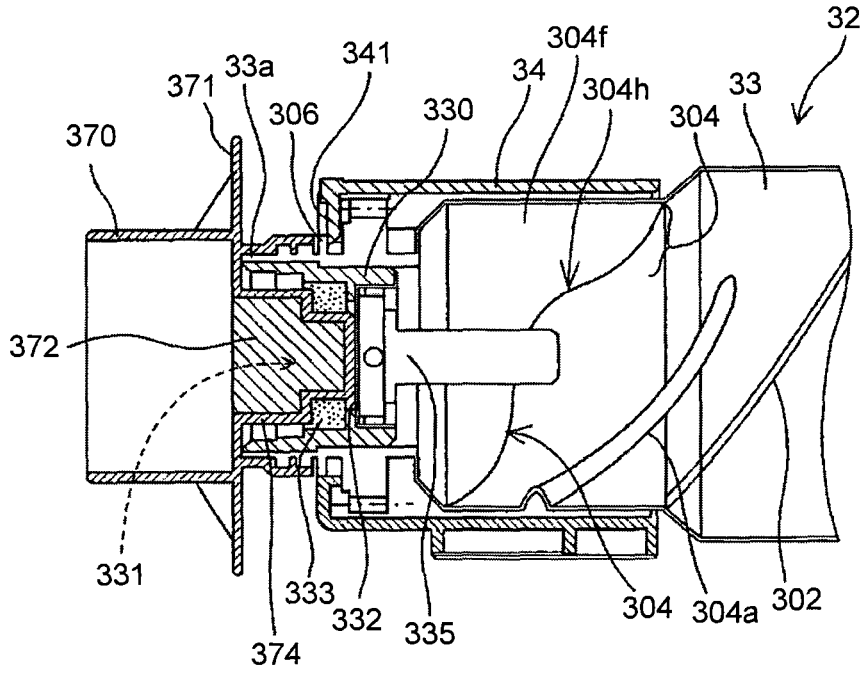
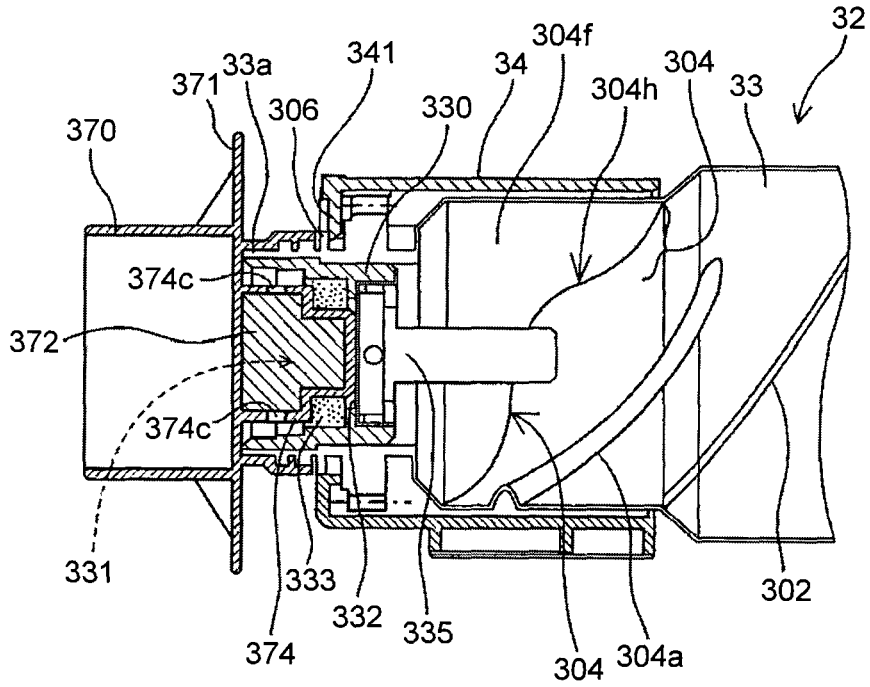

32
304f
341
33a
34
371
304h
33
306
330
304
370
372
331
333
332
335
304
304a
302
374

FIG.46


32
304f
341
33a
34
304
371
304h
33
306
330
370
374c
372
374c
331
333
332
335
374
304
304a
302

POWDER CONTAINER AND IMAGE FORMING APPARATUS

TECHNICAL FIELD

The present invention relates to a powder container that stores powder such as toner and an image forming apparatus including the powder container.

BACKGROUND ART

In an image forming apparatus such as a copying machine, a printer, and a facsimile that uses an electrophotographic process, a latent image formed on a photoreceptor is visualized with toner of a developing device. However, since toner is consumed when the latent image is developed, it is necessary to replenish toner into the developing device. Thus, a toner replenishing device as a powder supply device provided in the apparatus body conveys toner from a toner container as a powder container to the developing device to replenish toner into the developing device. With the developing device that replenishes toner in this manner, it is possible to perform developing continuously. Moreover, the toner container can be detachably attached to the toner replenishing device and is replaced with a new toner container having toner stored therein when the toner stored therein runs out.

As an example of a toner container detachably attached to the toner replenishing device, a toner container which includes a toner storing member that forms a storage unit that storing toner therein, and in which a spiral projection serving as a powder conveyor is provided on a cylindrical inner circumferential surface of the toner storing member is known (see Japanese laid-open Patent Application (JP-A) No. 2003-241496, JP-A 2005-221825, Japanese patent No. 4342958, JP-A No. 2002-202656, JP-A No. 2003-233247, JP-A No. 2009-276659, and JP-A No. 07-261492, for example). In such a toner container, when the toner storing member rotates in a state of being attached to the toner replenishing device, the toner stored therein is conveyed from one end side in the rotation axis direction of the toner storing member to the other end side. The toner is delivered from an opening provided on the other end side of the toner storing member toward the main body of the toner replenishing device.

JP-A Nos. 2009-276659 and 07-261492 each disclose a toner container in which toner stored in a storage unit is conveyed from one end side thereof to the other end side when a toner storing member rotates, and in which a conveying nozzle fixed to a toner replenishing device is inserted from an opening on the other end side of the toner storing member into the storage unit. A toner inlet is provided near a front end in the insertion direction of the conveying nozzle inserted from the opening of the toner storing member into the storage unit, and the conveying nozzle receives the toner in the toner storing member into the nozzle from the toner inlet in a state of being inserted in the toner container and conveys the toner toward the main body of the toner replenishing device. Moreover, the toner container has a nozzle insertion portion in which a nozzle insertion opening for inserting the conveying nozzle is provided in the opening at the other end of the toner storing member. Further, the toner container includes an opening blocking member that blocks the nozzle insertion opening before the conveying nozzle is inserted and opens the nozzle insertion opening when the conveying nozzle is inserted.

The opening blocking member included in the toner container disclosed in JP-A No. 2009-276659 is a shutter member that can slide in the nozzle insertion path provided in the toner container, and is biased by a spring from one end side of the nozzle insertion path to the other end side. In this structure, when the shutter member biased by the spring bumps against the vicinity of the nozzle insertion opening until the conveying nozzle is inserted, the nozzle insertion opening maintains a blocked state. Moreover, when the conveying nozzle is inserted, the front end of the conveying nozzle presses the shutter member so that the spring biasing the shutter member is contracted, whereby the shutter member can move from the other end side of the nozzle insertion path to one end side and the conveying nozzle can be inserted into the nozzle insertion path.

However, in the toner container disclosed in JP-A No. 2009-276659, a spring and an insertion path defining portion that supports the spring and forms a nozzle conveying path are required in addition to the shutter member which is an opening blocking member, and the structure that opens and blocks the nozzle insertion opening becomes complex.

On the other hand, the opening blocking member included in the toner container disclosed in JP-A No. 07-261492 is an elastic sheet member which is formed of a sheet-shaped elastic member and has a slit provided so as to penetrate from one surface to the other surface thereof. In the toner container disclosed in JP-A No. 07-261492, when a conveying nozzle is inserted in the slit of the elastic sheet member provided so as to block the nozzle insertion opening, the elastic sheet member is elastically deformed so that the slit is expanded. By expanding the slit in this way, the conveying nozzle can pass through portion of the nozzle insertion opening blocked by the elastic sheet member and the conveying nozzle can be inserted in the nozzle insertion opening. Since the nozzle insertion opening is opened and blocked by elastic deformation of the elastic sheet member, it is possible to simplify the structure of opening and blocking the nozzle insertion opening as compared to the toner container of JP-A No. 2009-276659.

In the toner container disclosed in No. JP-A 07-261492, in a state where the elastic sheet member is not elastically deformed, the slit is blocked and toner leakage can be prevented. However, when vibration or impact is applied to the toner container while conveying before it is attached to the toner replenishing device, vibration or impact may be transmitted to the elastic sheet member which may be temporarily elastically deformed, and a gap may be provided in the slit. When a gap is provided in the slit even if temporarily, toner in the storage unit may pass through the slit in the elastic sheet member. When toner passes through the slit in the elastic sheet member during conveying of the toner container, this can cause toner leakage.

In the foregoing description, the problem occurring in the toner container that stores toner as powder has been described. However, the same problem can occur in a powder container that stores powder different from toner. That is, the same problem can occur if a powder container includes an elastic sheet member that blocks a nozzle insertion opening when a powder conveying nozzle fixed to a powder conveying device is not inserted, and the elastic sheet member is elastically deformed to allow the powder conveying nozzle to pass when the conveying nozzle is inserted.

Therefore, there is a need to provide a powder container that includes an elastic sheet member that blocks a nozzle insertion opening in which a powder conveying nozzle that delivers powder stored therein to the outside and that can suppress leakage of powder in a state where a powder con-

veying device is not attached thereto, and to provide an image forming apparatus including the powder container.

DISCLOSURE OF INVENTION

It is an object of the present invention to at least partially solve the problems in the conventional technology.

According to an embodiment, there is provided a powder container that includes a container body that stores powder to be supplied to a powder conveying device; a nozzle insertion portion having a nozzle insertion opening through which a powder conveying nozzle of the powder conveying device is inserted into the container body; and an elastic sheet member formed of a plurality of sheet-shaped elastic bodies. The elastic sheet member blocks the nozzle insertion opening in a state where the powder conveying nozzle is not inserted. Inserting the powder conveying nozzle causes the elastic sheet member to elastically deform so that the powder conveying nozzle passes through a blocked portion of the nozzle insertion opening. At least a part of the plurality of elastic bodies is arranged so as to overlap in at least a diametric direction of the nozzle insertion opening in an insertion direction of the powder conveying nozzle.

The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** illustrates a toner container according to a first embodiment, in which (a) is an exploded perspective view of the toner container and (b) is a front view of a nozzle receiver when seen from the other end side.

FIG. **2** is a diagram illustrating an entire configuration of a copying machine, common to all embodiments.

FIG. **3** is a schematic view illustrating an image forming unit of the copying machine.

FIG. **4** is a schematic view illustrating a state where a toner container is provided in a toner replenishing device of the copying machine.

FIG. **5** is a schematic perspective view illustrating a state where a toner container is provided in a toner container receiving portion of the copying machine.

FIG. **6** is a perspective view illustrating a toner container according to the first embodiment.

FIG. **7** is a perspective view illustrating the toner container of FIG. **6** during storage.

FIG. **8** is a perspective view illustrating the toner container of FIG. **6** in a state where a container front end cover is detached therefrom.

FIG. **9** is a perspective view illustrating a toner container and a toner replenishing device before the toner container is attached thereto.

FIG. **10** is a perspective view illustrating a toner container and a toner replenishing device in a state where the toner container is attached thereto.

FIG. **11** is a cross-sectional view illustrating a toner container and a toner replenishing device before the toner container is attached thereto.

FIG. **12** is a cross-sectional view illustrating a toner container and a toner replenishing device in the process of attaching the toner container thereto.

FIG. **13** is a cross-sectional view illustrating a toner container and a toner replenishing device in a state where the toner container is attached thereto.

FIG. **14** is a cross-sectional view illustrating a toner container in a state where a nozzle receiver is detached from a container body.

FIG. **15** is a cross-sectional view illustrating a toner container in a state where the nozzle receiver is attached to the container body from the state of FIG. **14**.

FIG. **16** is a cross-sectional view illustrating a nozzle shutter, common to all embodiments.

FIG. **17** is a perspective view of the nozzle shutter of FIG. **16** when seen from a front end side of the nozzle.

FIG. **18** is a cross-sectional view near a conveying nozzle of a toner replenishing device, common to all embodiments.

FIG. **19** is a perspective cross-sectional view illustrating near a nozzle opening of the conveying nozzle of FIG. **18**.

FIG. **20** is a timing chart of a configuration in which a toner container is rotated first and a conveying screw is rotated subsequently.

FIG. **21** is a diagram illustrating an elastic sheet according to Example 1 of the first embodiment.

FIG. **22** is an enlarged cross-sectional view of a nozzle receiver and a conveying nozzle in a state where the toner container of the first embodiment is attached to the toner replenishing device.

FIG. **23** is a front view when an elastic sheet according to Example 1 of the first embodiment seen from a front end side in a state where the toner container is attached to the toner replenishing device.

FIG. **24** is a diagram illustrating an elastic sheet according to Example 2 of the first embodiment.

FIG. **25** is a diagram illustrating an elastic sheet according to Example 3 of the first embodiment.

FIG. **26** is a front view when the elastic sheet of FIG. **25** is seen from a front end side in a state where the toner container is attached to the toner replenishing device.

FIG. **27** is a diagram illustrating an elastic sheet according to Example 4 of the first embodiment.

FIG. **28** is a diagram of an elastic sheet according to Example 6 of a second embodiment.

FIG. **29** illustrates a nozzle shutter having a donut-shaped sealing member, in which (a) is a perspective view and (b) is a cross-sectional view.

FIG. **30** is a cross-sectional view illustrating a cross-section orthogonal to a rotation shaft at the position of a scooping portion.

FIG. **31** is a cross-sectional view illustrating a configuration in which an extension portion in an E-E cross-section in FIG. **13** functions as a relaying means.

FIG. **32** illustrates cross-sectional views (schematic views) of the E-E cross-section in FIG. **13**, in which (a) illustrates a configuration in which the extension portion does not function as the relaying means and (b) illustrates a configuration in which the extension portion functions as the relaying means.

FIG. **33** is a graph illustrating a relation between an amount of toner remaining in the container and a toner replenishing speed according to Example and Comparative Example.

FIG. **34** illustrates the toner container according to the second embodiment, in which (a) is an exploded perspective view of the toner container and (b) is a front view of a nozzle receiver when seen from the other end side.

FIG. **35** is a diagram illustrating an arrangement of three elastic sheets according to Example 1 of the second embodiment.

FIG. **36** is a diagram illustrating an arrangement of three elastic sheets according to Example 2 of the second embodiment.

FIG. **37** is a diagram illustrating an arrangement of three elastic sheets according to Example 3 of the second embodiment.

FIG. **38** is a diagram illustrating an arrangement of three elastic sheets according to Example 4 of the second embodiment.

FIG. **39** is a diagram illustrating an arrangement of three elastic sheets according to Example 5 of the second embodiment.

FIG. **40** is a diagram illustrating a contact position between an elastic sheet and a front end of a conveying nozzle, common to all embodiments.

FIG. **41** illustrates a toner container according to a third embodiment, in which (a) is a perspective view of a nozzle receiver having scooping ribs integrated therewith, (b) is a cross-sectional view illustrating a positional relation between the nozzle receiver of (a) and a conveying nozzle, and (c) is a cross-sectional view illustrating a side part of the toner container having the nozzle receiver of (a) mounted thereon.

FIG. **42** is a cross-sectional view illustrating the vicinity of a front end of a toner container having a cap member attached thereto according to Example 1 of a fourth embodiment.

FIG. **43** is a cross-sectional view illustrating a toner container according to Example 2 of the fourth embodiment.

FIG. **44** is a cross-sectional view illustrating a toner container according to Example 3 of the fourth embodiment.

FIG. **45** is a cross-sectional view illustrating a toner container according to Example 4 of the fourth embodiment.

FIG. **46** is a cross-sectional view illustrating a toner container according to Example 5 of the fourth embodiment.

BEST MODE(S) FOR CARRYING OUT THE INVENTION

Hereinafter, a plurality of embodiments of the present invention will be described with reference to the drawings. In the respective embodiments, the same members or members having the same functions will be denoted by the same reference numerals, and the description thereof will not be repeated. The following description is an example and the scope of the claim is not limited thereto. In the drawings, Y, M, C, and K are subscripts attached to constituent members corresponding to the colors yellow, magenta, cyan, and black, and may be omitted appropriately.

First Embodiment

First, a configuration of a first embodiment of the present invention in which the present invention is applied to a copying machine (hereinafter referred to as a copying machine **500**) as an image forming apparatus will be described.

FIG. **2** is a diagram illustrating a schematic configuration of the copying machine **500** according to the present embodiment. The copying machine **500** includes a copying machine body (hereinafter referred to as a printer unit **100**), a sheet feeding table (hereinafter referred to as a sheet feeding unit **200**), and a scanner (hereinafter referred to as a scanner unit **400**) attached onto the printer unit **100**.

Four toner containers **32** (Y, M, C, and K) as powder containers corresponding to respective colors (yellow, magenta, cyan, and black) are detachably (replaceably) attached to a toner container receiving portion **70** that is provided in an upper part of the printer unit **100**. An intermediate transfer unit **85** is arranged below the toner container receiving portion **70**.

The intermediate transfer unit **85** includes an intermediate transfer belt **48**, four primary transfer bias rollers **49** (Y, M, C, and K), a secondary transfer backup roller **82**, a plurality of tension rollers, and an intermediate transfer cleaning device. The intermediate transfer belt **48** is stretched and supported by a plurality of roller members and moves endlessly in the direction indicated by an arrow in FIG. **2** by rotation of the secondary transfer backup roller **82** which is one of the plurality of roller members.

Four image forming units **46** (Y, M, C, and K) corresponding to the respective colors are arranged in parallel in the printer unit **100** so as to face the intermediate transfer belt **48**. Moreover, corresponding four toner replenishing devices **60** (Y, M, C, and K) are arranged below the four toner containers **32** (Y, M, C, and K). Moreover, the toner stored in the toner containers **32** (Y, M, C, and K) is supplied (replenished) into developing devices (powder consuming units) of the image forming units **46** (Y, M, C, and K) corresponding to the respective colors by the corresponding toner replenishing devices **60** (Y, M, C, and K).

Moreover, as illustrated in FIG. **2**, the printer unit **100** includes an exposure device **47** which is a latent image forming means and which is disposed below the four image forming units **46**. The exposure device **47** exposes the surface of a photoreceptor **41** to be described later with light based on image information of a document image read by the scanner unit **400** or image information input from an external device such as a personal computer and forms an electrostatic latent image on the surface of the photoreceptor **41**. Although the exposure device **47** included in the printer unit **100** employs a laser beam scanner that uses laser diodes, an exposure means may employ an optional configuration that uses an LED array.

FIG. **3** is a schematic diagram illustrating a schematic configuration of the image forming unit **46**Y corresponding to yellow.

The image forming unit **46**Y includes a drum-shaped photoreceptor **41**Y which is a latent image carrier. Further, in the image forming unit **46**Y, a charging roller **44**Y which is a charging means, a developing device **50**Y which is a developing means, a photoreceptor cleaning device **42**Y, a neutralization device, and the like are arranged around the photoreceptor **41**Y. Image forming processes (including charging step, exposure step, developing step, transfer step, and cleaning step) are performed on the photoreceptor **41**Y whereby a yellow image is formed on the photoreceptor **41**Y.

The other three image forming units **46** (M, C, and K) have approximately the same configuration as the image forming unit **46**Y corresponding to yellow except that the colors of toner used are different, and images of the colors corresponding to the respective toner components are formed on the photoreceptors **41** (M, C, and K). Hereinafter, the description of the other three image forming units **46** (M, C, and K) will be omitted appropriately, and the image forming unit **46**Y corresponding to yellow only will be described.

The photoreceptor **41**Y is rotated in the clockwise direction in FIG. **3** by a driving motor. The surface of the photoreceptor **41**Y at the position where the surface faces the charging roller **44**Y is uniformly charged (charging step). After that, when the surface of the photoreceptor **41**Y reaches an irradiation position where the surface is irradiated with a laser beam L emitted from the exposure device **47**, exposure scanning is carried out at this position, and an electrostatic latent image corresponding to yellow is formed on the surface (exposure step). After that, when the surface of the photore-

ceptor **41**Y reaches a position where the surface faces the developing device **50**Y, the electrostatic latent image is developed at this position, and a yellow toner image is formed (developing step).

The four primary transfer bias rollers **49** (Y, M, C, and K) of the intermediate transfer unit **85** and the photoreceptors **41** (Y, M, C, and K) form primary transfer nips with the intermediate transfer belt **48** interposed. A transfer bias having a polarity opposite to toner is applied to the primary transfer bias rollers **49** (Y, M, and K).

When the surface of the photoreceptor **41**Y on which a toner image is formed in the developing step reaches the primary transfer nip at which the surface faces the primary transfer bias roller **49**Y with the intermediate transfer belt **48** interposed, the toner image on the photoreceptor **41**Y is transferred to the intermediate transfer belt **48** at the primary transfer nip (primary transfer step). In this case, a very small amount of toner that has not been transferred remains on the photoreceptor **41**Y. After the toner image is transferred to the intermediate transfer belt **48** at the primary transfer nip, the surface of the photoreceptor **41**Y reaches a position where the surface faces the photoreceptor cleaning device **42**Y. At this position, the non-transferred toner remaining on the photoreceptor **41**Y is mechanically collected by a cleaning blade **42***a*. Finally, when the surface of the photoreceptor **41**Y reaches a position where the surface faces the neutralization device, a residual potential on the photoreceptor **41**Y is removed. In this way, a series of image forming processes performed on the photoreceptor **41**Y ends.

Such image forming processes are also performed on the other image forming units **46** (M, C, and K) in the same manner as the image forming unit **46**Y. That is, a laser beam L based on image information is irradiated from the exposure device **47** arranged below the image forming units **46** (M, C, and K) toward the photoreceptors **41** (M, C, and K) of the respective image forming units **46** (M, C, and K). Specifically, the exposure device **47** emits a laser beam L from a light source so as to be radiated onto the respective photoreceptors **41** (M, C, and K) with a plurality of optical elements while scanning the laser beam L with a rotating polygon mirror. After that, a developing step is performed, and the toner images of the respective colors formed on the respective photoreceptors **41** (M, C, and K) are transferred to the intermediate transfer belt **48**.

In this case, the intermediate transfer belt **48** rotates in the direction indicated by the arrow in FIG. **2** to sequentially pass through the primary transfer nips of the respective primary transfer bias rollers **49** (Y, M, C, and K). In this way, the toner images of the respective colors on the respective photoreceptors **41** (Y, M, and K) are superimposed and primarily transferred to the intermediate transfer belt **48**, and a color toner image is formed on the intermediate transfer belt **48**.

The intermediate transfer belt **48** on which the toner images of the respective colors are superimposed and transferred so that the color toner image is formed reaches a position where it faces a secondary transfer roller **89**. At this position, the secondary transfer backup roller **82** and the secondary transfer roller **89** configurate a secondary transfer nip with the intermediate transfer belt **48** interposed therebetween. Moreover, the color toner image formed on the intermediate transfer belt **48** is transferred to a recording medium P such as a transfer sheet conveyed to the position of the secondary transfer nip. In this case, toner that has not been transferred to the recording medium P remains on the intermediate transfer belt **48**. When the intermediate transfer belt **48** having passed through the secondary transfer nip reaches the position of an intermediate transfer cleaning device, the non-transferred toner on the surface thereof is collected. In this way, a series of transfer processes performed on the intermediate transfer belt **48** ends.

Next, the movement of the recording medium P will be described.

The recording medium P conveyed to the secondary transfer nip described above is a recording medium which is conveyed from a sheet feeding tray **26** of the sheet feeding unit **200** arranged below the printer unit **100** via a sheet feeding roller **27**, a registration roller pair **28**, and the like. Specifically, a plurality of recording media P is stacked and stored in the sheet feeding tray **26**. When the sheet feeding roller **27** is rotated in the counter-clockwise direction in FIG. **2**, an uppermost recording medium P is conveyed toward a roller nip configurated by two rollers of the registration roller pair **28**.

The recording medium P conveyed to the registration roller pair **28** temporarily stops at the position or the roller nip of the registration roller pair **28** that stops rotating. The registration roller pair **28** is rotated in synchronization with the point in time when the color toner image on the intermediate transfer belt **48** reaches the secondary transfer nip, and the recording medium P is conveyed toward the secondary transfer nip. After that, when the recording medium P passes through the secondary transfer nip, the color toner image on the intermediate transfer belt **48** is transferred to the recording medium P.

The recording medium P to which the color toner image is transferred at the secondary transfer nip is conveyed to the position of a fixing device **86**. In the fixing device **86**, the color toner image transferred to the surface is fixed onto the recording medium P by the heat and pressure applied by a fixing belt and a pressing roller. The recording medium P having passed through the fixing device **86** is discharged outside the apparatus by passing between the rollers of a sheet discharging roller pair **29**. The recording medium P discharged outside the apparatus by the sheet discharging roller pair **29** is sequentially stacked on a stacking portion **30** as an output image. In this way, a series of image forming processes in the copying machine **500** is completed.

Next, the configuration and operation of the developing device **50** in the image forming unit **46** will be described in further detail. In this description, although the image forming unit **46**Y corresponding to yellow will be described by way of an example, the same is true for the image forming units **46** (M, C, and K) of the other colors.

As illustrated in FIG. **3**, the developing device **50**Y includes a developing roller **51**Y, a doctor blade **52**Y, two developer conveying screws **55**Y, and a toner density detection sensor **56**Y. The developing roller **51**Y faces the photoreceptor **41**Y, and the doctor blade **52**Y faces the developing roller **51**Y. Moreover, the two developer conveying screws **55**Y are arranged in two developer accommodating portions (**53**Y and **54**Y). The developing roller **51**Y includes a magnet roller that is provided therein and a sleeve that rotates around the magnet roller. A two-component developer G that is made up of carrier and toner is stored in the first and second developer accommodating portions **53**Y and **54**Y. The second developer accommodating portion **54**Y communicates with a falling path defining portion **64**Y through an opening that is provided above the second developer accommodating portion **54**Y. Moreover, the toner density detection sensor **56**Y detects a toner density of the developer G in the second developer accommodating portion **54**Y.

The developer G in the developing device **50** circulates between the first and second developer accommodating portions **53**Y and **54**Y while being stirred by the two developer conveying screws **55**Y. The developer G in the first developer accommodating portion **53**Y is supplied to and carried on the

surface of the sleeve of the developing roller **51**Y by a magnetic field generated by the magnet roller in the developing roller **51**Y while being conveyed toward one of the developer conveying screws **55**Y. The sleeve of the developing roller **51**Y is rotated in the counter-clockwise direction as indicated by an arrow in FIG. **3**, and the developer G carried on the developing roller **51**Y moves on the developing roller **51**Y with rotation of the sleeve. In this case, toner in the developer G is charged into potential having a polarity opposite to the carrier by triboelectric charging with the carrier in the developer G to be electrostatically adsorbed in the carrier. Then, the toner is carried on the developing roller **51**Y together with the carrier attracted by the magnetic field generated on the developing roller **51**Y.

The developer G carried on the developing roller **51**Y is conveyed in the direction indicated by the arrow in FIG. **3** and reaches a doctor portion at which the doctor blade **52**Y and the developing roller **51**Y face each other. When the developer G on the developing roller **51**Y passes through the doctor portion, the amount thereof is adjusted appropriately, and after that, the developer G is conveyed up to a developing area which is a position where the developing roller **51**Y faces the photoreceptor **41**Y. In the developing area, the toner in the developer G is adsorbed in the latent image formed on the photoreceptor **41**Y by a developing electric field generated between the developing roller **51**Y and the photoreceptor **41**Y. The developer G remaining on the surface of the developing roller **51**Y having passed through the developing area reaches a position above the first developer accommodating portion **53**Y with rotation of the sleeve. At this position, the developer G is separated from the developing roller **51**Y.

The developer G in the developing device **50**Y is adjusted so that the toner density is within a predetermined range. Specifically, toner stored in the toner container **32**Y is replenished into the second developer accommodating portion **54**Y by a toner replenishing device **60**Y to be described later in response to the amount consumed by development, of the toner included in the developer G in the developing device **50**Y.

The toner replenished into the second developer accommodating portion **54**Y circulates between the first and second developer accommodating portions **53**Y and **54**Y while being mixed and stirred together with the developer G by the two developer conveying screws **55**Y.

Next, the toner replenishing devices **60** (Y, M, C, and K) will be described.

FIG. **4** is a schematic view illustrating a state where the toner container **32**Y is provided in the toner replenishing device **60**Y, and FIG. **5** is a schematic perspective view illustrating a state where four toner containers **32** (Y, M, C, and K) are provided in the toner container receiving portion **70**.

The toner in the respective toner containers **32** (Y, M, C, and K) provided in the toner container receiving portion **70** of the printer unit **100** is appropriately replenished into the respective developing devices **50** (Y, M, C, and K). In this case, the toner in the respective toner containers **32** (Y, M, C, and K) is replenished by the toner replenishing devices **60** (Y, M, C, and K) provided for the respective toner colors. The four toner replenishing devices **60** (Y, M, C, and K) and the toner containers **32** (Y, M, C, and K) have approximately the same structure except that the colors of the toner components used in the image forming processes are different. Therefore, hereinafter, the toner replenishing device **60**Y and the toner container **32**Y corresponding to yellow only will be described, and the description of the toner replenishing devices **60** (M, C, and K) and the toner containers **32** (M, C, and K) corresponding to the other three colors will be omitted appropriately.

The toner replenishing devices **60** (Y, M, C, and K) includes the toner container receiving portion **70**, conveying nozzles **611** (Y, M, C, and K), conveying screws **614** (Y, M, C, and K), falling path defining portions **64** (Y, M, C, and K), and container rotation driving units **91** (Y, M, C, and K).

When the toner container **32**Y moves in the direction indicated by arrow Q in the figure to be attached to the toner container receiving portion **70** of the printer unit **100**, the conveying nozzle **611**Y which is a conveying nozzle of the toner replenishing device **60**Y is inserted from a front end side of the toner container **32**Y in response to the attaching operation. In this way, the toner container **32**Y communicates with the conveying nozzle **611**Y. The details of a configuration in which a communication state is created in response to the attaching operation will be described later.

The toner container **32**Y of the present embodiment is an approximately cylindrical toner bottle and mainly includes a container front end cover **34**Y non-rotatably held in the toner container receiving portion **70** and a container body **33**Y having a container gear **301**Y integrated therewith. The container body **33**Y is held so as to be rotatable in relation to the container front end cover **34**Y.

The toner container receiving portion **70** mainly includes a cap portion **73**, a container receiving portion **72**, and an insertion opening defining portion **71**. The cap portion **73** is a portion for holding the container front end cover **34**Y of the toner container **32**Y, and the container receiving portion **72** is a portion for holding the container body **33**Y of the toner container **32**Y. Moreover, the insertion opening defining portion **71** is a portion that forms an insertion opening when the toner container **32**Y is attached to the container receiving portion **72**. When a body cover provided on the front side (the front side in the direction perpendicular to the drawing sheet of FIG. **2**) of the copying machine **500** is opened, the insertion opening defining portion **71** of the toner container receiving portion **70** is revealed. Moreover, in a state where the longitudinal direction of the respective toner containers **32** (Y, M, C, and K) is arranged in the horizontal direction, operation (operation of arranging the longitudinal direction of the toner container **32** in an attaching and detaching direction) of attaching and detaching the respective toner containers **32** (Y, M, C, and K) from the front side of the copying machine **500** is performed. A set cover **608**Y in FIG. **4** is a part of the cap portion **73** of the toner container receiving portion **70**.

The container receiving portion **72** is provided such that the length in the longitudinal direction is approximately the same as the length in the longitudinal direction of the container body **33**Y. Moreover, the cap portion **73** is provided on the other end side in the longitudinal direction (attaching and detaching direction) of the container receiving portion **72**, and the insertion opening defining portion **71** is provided on one end side in the longitudinal direction of the container receiving portion **72**. Thus, in response to the attaching operation of the toner container **32**Y, the container front end cover **34**Y passes through the insertion opening defining portion **71** and then temporarily slides on the container receiving portion **72** and is then attached to the cap portion **73**.

In a state where the container front end cover **34**Y is attached to the cap portion **73**, when rotational driving force is input to the container gear **301**Y from the container rotation driving unit **91**Y that is configurated of a driving motor, a driving gear, and the like, the container body **33**Y is rotated in the direction indicated by arrow A in FIG. **4**. When the container body **33**Y itself rotates, the toner stored in the container

body **33**Y is conveyed from the left to the right in FIG. **4** along the longitudinal direction of the container body by a spiral projection (serving as a powder conveyor) **302**Y, provided in a spiral form on the inner circumferential surface of the container body **33**Y. As a result, the toner is supplied into the conveying nozzle **611**Y from the side of the container front end cover **34**Y.

The conveying screw **614**Y is disposed in the conveying nozzle **611**Y, and when rotational driving force is input from the container rotation driving unit **91**Y to a conveying screw gear **605**Y, the conveying screw **614**Y rotates to convey the toner supplied into the conveying nozzle **611**Y. A downstream end in the conveying direction of the conveying nozzle **611**Y is connected to the falling path defining portion **64**Y, and the toner conveyed by the conveying screw **614**Y free-falls along the falling path defining portion **64**Y and is replenished into the developing device **50**Y (the second developer accommodating portion **54**Y).

When the toner containers **32** (Y, M, C, and K) reach their service life (the toner stored therein almost runs out and the container is empty), the toner containers are replaced with a new one. A knob **303** is provided on an end in the longitudinal direction of the toner container **32** opposite to the container front end cover **34**, and the attached toner container **32** can be taken out when an operator pulls the knob **303** during replacement.

A controller **90** may calculate a toner consumption amount based on the image information used by the exposure device **47** and determine that it is necessary to supply toner to the developing device **50**Y. Moreover, the controller **90** may detect a decrease in the toner density in the developing device **50**Y based on the detection result of the toner density detection sensor **56**Y. In these cases, the container rotation driving unit **91**Y is rotated under the control of the controller **90** to rotate the container body **33**Y of the toner container **32**Y and the conveying screw **614**Y for a predetermined period so that toner is replenished to the developing device **50**Y. Moreover, since toner replenishment is performed by rotating the conveying screw **614**Y disposed in the conveying nozzle **611**Y, it is possible to accurately calculate the amount of toner supplied from the toner container **32**Y by detecting the number of rotations of the conveying screw **614**Y. When the accumulated amount of toner supply calculated from the time when the toner container **32**Y is attached reaches the amount of toner in the toner container **32**Y during attachment, a message requesting the replacement of the toner container **32**Y is displayed on a display unit of the copying machine **500** by regarding that toner is not present in the toner container **32**Y.

Moreover, even when the toner density detection sensor **56**Y detects a decrease in the toner density to execute toner replenishing operation and repeatedly determine whether the toner density has been recovered, recovery of the toner density may not be detected by the toner density detection sensor **56**Y. In this case, a message requesting the replacement of the toner container **32**Y is displayed on the display unit of the copying machine **500** by regarding that toner is not present in the toner container **32**Y.

In the toner replenishing device **60**Y of the present embodiment, the amount of toner supplied to the developing device **50**Y is controlled based on the number of rotations of the conveying screw **614**Y. Thus, the toner having passed through the conveying nozzle **611**Y is directly conveyed to the developing device **50**Y through the falling path defining portion **64**Y without the amount supplied to the developing device **50**Y being controlled. A temporarily toner storage unit such as a toner hopper may be provided in such a toner replenishing device **60**Y as in the present embodiment in which the conveying nozzle **611**Y is inserted to the toner container **32**Y. Moreover, the amount of toner supplied to the developing device **50**Y may be controlled by controlling the amount of toner conveyed from the temporarily toner storage unit to the developing device **50**Y.

Moreover, in the toner replenishing device **60**Y of the present embodiment, although the toner supplied into the conveying nozzle **611**Y is conveyed by the conveying screw **614**Y, a configuration that conveys the toner supplied into the conveying nozzle **611**Y is not limited to a screw member. As in JP 2009-276659 A, a configuration that applies conveying force other than the screw member such as a configuration that generates negative pressure in the opening of the conveying nozzle **611**Y using a powder pump may be used.

In the configuration where the temporarily toner storage unit is provided, a toner end sensor is provided so as to detect a state where the amount of toner stored in the temporarily toner storage unit reaches a predetermined amount. Moreover, when the toner end sensor detects a toner-end state, the container body **33**Y and the conveying screw **614**Y are rotated for a predetermined period to replenish toner into the temporarily toner storage unit. Further, when the toner-end state detected by the toner end sensor is not cleared even if such control is repeatedly performed for a predetermined number of times, a message requesting the replacement of the toner container **32**Y is displayed on the display unit of the copying machine **500** by regarding that toner is not present in the toner container **32**Y. In this manner, in the configuration in which the state where toner is not present in the toner container **32**Y is detected based on the toner-end state detected by the toner end sensor, it is not necessary to calculate the accumulated amount of toner supply calculated from the time when the toner container **32**Y is attached. However, in the configuration where the temporarily toner storage unit is not provided as in the toner replenishing device **60**Y of the present embodiment, it is possible to decrease the size of the toner replenishing device **60**Y and to decrease the size of the entire copying machine **500**.

Next, the toner containers **32** (Y, M, C, and K) and the toner replenishing devices **60** (Y, M, C, and K) of the present embodiment will be described in further detail. As described above, the toner containers **32** (Y, M, C, and K) and the toner replenishing devices **60** (Y, M, C, and K) have approximately the same configuration except that the colors of toner used are different. Thus, in the following description, the subscripts Y, M, C, and K representing the colors of toner used will be omitted.

FIG. **6** is a perspective view illustrating the toner container **32** of the present embodiment. FIG. **7** is a perspective view illustrating the toner container **32** during storage and illustrates a state where a cap (cap member) **370** as a sealing member that seals a front end opening **305** of the toner container **32** illustrated in FIG. **6**.

Moreover, FIG. **1** illustrates the toner container **32**, in which (a) is an exploded perspective view of the toner container **32**, and (b) is a front view of a nozzle receiver (serving as a nozzle reception member) **330** included in the toner container **32** when seen from the other end side. The cap **370** illustrated in FIG. **1**(*a*) and FIG. **7** is a member that is detached from the body of the toner container **32** when the toner container **32** is attached to the toner replenishing device **60**.

FIG. **8** is a perspective view of the toner container **32** in a state where the container front end cover **34** is detached. As illustrated in FIG. **8**, the toner container **32** having the container front end cover **34** detached therefrom includes a con-

tainer body **33** and the nozzle receiver **330** that includes a nozzle insertion opening (serving as a nozzle inlet) **331**.

FIG. **9** is a perspective view illustrating a front end of the toner container **32** and the toner replenishing device **60** before the toner container **32** is attached thereto. FIG. **10** is a perspective view illustrating the front end of the toner container **32** and the toner replenishing device **60** in a state where the toner container **32** is attached thereto.

FIG. **11** is a cross-sectional view illustrating the front end of the toner container **32** and the toner replenishing device **60** before the toner container **32** is attached thereto. FIG. **12** is a cross-sectional view illustrating the front end of the toner container **32** and the toner replenishing device **60** in the process of attaching the toner container **32** thereto. FIG. **13** is a cross-sectional view illustrating the front end of the toner container **32** and the toner replenishing device **60** in a state where the toner container **32** is attached thereto. In FIGS. **11** to **13**, a driving motor **603** is not depicted.

The toner replenishing device **60** includes the conveying nozzle **611** that has the conveying screw **614** therein. Moreover, the toner replenishing device **60** includes a nozzle shutter **612**. The nozzle shutter **612** blocks a nozzle opening **610** provided in the conveying nozzle **611** in anon-attachment state (the state of FIGS. **9** and **11**) before the toner container **32** is attached thereto. Moreover, the nozzle shutter **612** opens the nozzle opening **610** in an attachment state (the state of FIGS. **10** and **13**) where the toner container **32** is attached thereto. On the other hand, the nozzle insertion opening **331** in which the conveying nozzle **611** is inserted during attachment is provided at the center of the front end surface of the toner container **32**, and an elastic sheet **332** which is a container shutter sheet that blocks the nozzle insertion opening **331** during non-attachment is provided.

The toner container **32** will be described.

As illustrated, the toner container **32** mainly includes the container body **33** and the container front end cover **34**. FIG. **14** is a cross-sectional view illustrating the toner container **32** in a state where the nozzle receiver **330** is detached from the container body **33**. Moreover, FIG. **15** is a cross-sectional view illustrating the toner container **32** (the toner container **32** in a state where the container front end cover **34** is detached therefrom similarly to FIG. **8**) in a state where the nozzle receiver **330** is attached to the container body **33** from the state of FIG. **14**.

The container body **33** is approximately cylindrical to rotate about a central axis of the cylinder as a rotation axis. Hereinafter, a direction parallel to the rotation axis will be referred to as a "rotation axis direction", and in the rotation axis direction, a front end side during attachment, on which the container front end cover **34** of the toner container **32** is disposed will be referred to as a "front end side". Moreover, a side (the side opposite to the front end side) on which the knob **303** of the toner container **32** is disposed will be referred to as a "rear end side" or "container inner side". The longitudinal direction of the toner container **32** is the rotation axis direction, and in a state where the toner container **32** is attached to the toner replenishing device **60**, the rotation axis direction is the horizontal direction. A portion of the container body **33** located closer to the rear end side than the container gear **301** has a larger outer diameter than that located on the front end side, and the spiral projection (serving as a powder conveyor) **302** is provided on the inner circumferential surface thereof. Moreover, when the container body **33** rotates in the direction indicated by arrow A in the figure, conveying force is applied to the toner in the container body **33** by the action of the spiral projection **302** so that the toner is conveyed from one end side (rear end side) to the other end side (front end side) in the rotation axis direction.

A scooping portion **304** is provided on the inner wall on the front end side of the container body **33** so that the toner which has been conveyed toward the front end side by the spiral projection **302** with rotation of the container body **33** in the direction indicated by arrow A in the figure is scooped upward with rotation of the container body **33**. The scooping portion **304** includes a convex portion **304*h*** and a scooping wall surface **304*f***. The convex portion **304*h*** is a portion that protrudes on the inner side of the container body **33** so as to form a ridge line of a mountain toward the center of rotation of the container body **33** while defining a spiral line. The scooping wall surface **304*f*** is a wall surface that is on the downstream side when seen from the container rotation direction among the wall surface of the protruding portion that extends from the convex portion **304*h*** (the ridge line) to the inner wall of the circumferential surface of the container body **33**. Moreover, when the scooping wall surface **304*f*** is on the lower side, the toner entering into an inner space facing the scooping portion **304** by the conveying force of the spiral projection **302** is scooped upward by the scooping wall surface **304*f*** with rotation of the container body **33**. As a result, the toner can be scooped upward further than the inserted conveying nozzle **611**.

Moreover, as illustrated in FIGS. **11** to **13** and other figures, a scooping spiral projection **304*a*** provided in a spiral shape is also provided on the inner circumferential surface of the scooping portion **304** so as to convey the toner in a manner similarly to the spiral projection **302**.

The container gear **301** is provided in a portion of the container body **33** located further closer to the front end side than the scooping portion **304**. A gear exposing opening **34*a*** is provided in the container front end cover **34** so that a portion (the back side in FIG. **6**) of the container gear **301** is exposed in a state of being attached to the container body **33**. Moreover, when the toner container **32** is attached to the toner replenishing device **60**, the container gear **301** exposed from the gear exposing opening **34*a*** meshes with a container driving output gear **601** of the toner replenishing device **60**.

A cylindrical container opening **33*a*** is provided in a portion of the container body **33** located further closer to the front end side than the container gear **301**. Moreover, when an attaching portion **337** of the nozzle receiver **330** is press-fitted into the container opening **33*a***, the nozzle receiver **330** can be attached to the container body **33**. A method of attaching the nozzle receiver **330** is not limited to press-fitting, and an adhesive agent or screws may be used.

In the toner container **32**, after toner is filled in the container body **33** from the opening of the container opening **33*a***, the nozzle receiver **330** is attached to the container opening **33*a*** of the container body **33**.

Moreover, a cover hook stopper **306** is provided on a portion of the container opening **33*a*** of the container body **33** closer to the container gear **301**. The container front end cover **34** is attached to the toner container **32** (the container body **33**) in the state illustrated in FIG. **8** from the front end side (the bottom left side in FIG. **8**). As a result, the container body **33** passes through the container front end cover **34** in the rotation axis direction, and a cover claw portion **341** provided on an upper portion of the container front end cover **34** is hooked by the cover hook stopper **306**. The cover hook stopper **306** is provided on an entire outer circumferential surface of the container opening **33*a*** and interposes the cover claw portion **341** in the rotation axis direction together with the container gear **301** to thereby restrict the movement of the container

front end cover **34** in the axial direction. With such a configuration, the container body **33** and the container front end cover **34** are provided so as to be rotatable in relation to each other.

Moreover, the container body **33** is provided according to a biaxial orientation blow molding method (see JP-A Nos. 2003-241496 and 2005-221825, and Japanese Patent No. 4342958). The biaxial orientation blow molding method generally includes two steps of a preform molding step and a stretching blow molding step. In the preform molding step, a test tube-shaped preform is molded according to injection molding using a resin. By this injection molding, the container opening **33***a*, the cover hook stopper **306**, and the container gear **301** are formed in a test tube-shaped opening portion. The stretching blow molding step involves heating and softening the preform which has been cooled and separated from a mold after the preform molding step and performing blow molding and stretching the preform.

In the container body **33** of the present embodiment, portion located closer to the rear end side than the container gear **301** is molded by the stretching blow molding step. That is, the scooping portion **304**, and the portion where the spiral projection **302** is provided, and the knob **303** are molded by the stretching blow molding step.

In the container body **33**, since the container gear **301**, the container opening **33***a*, and the respective portions disposed on the front end side than the container gear **301** such as the cover hook stopper **306** have the shapes of the injection-molded preform, these portions can be molded with high accuracy. On the other hand, since the scooping portion **304**, the portion where the spiral projection **302** is provided, and the knob **303** are stretch-molded in the stretching blow molding step, these portions are not molded with high accuracy.

Next, the nozzle receiver **330** attached to the container body **33** will be described.

As illustrated in FIGS. **1**, **14**, and **15**, the nozzle receiver **330** includes the attaching portion **337**, an elastic sheet **332**, a container seal **333** which is a container sealing member, and a sheet stopper **335**.

Moreover, the sheet stopper **335** includes a pair of extension portions **335***a*.

The elastic sheet **332** is formed of a thin film sheet made from an elastic member having flexibility. Moreover, in the toner container **32** of the present embodiment, the elastic sheet **332** includes two elastic sheet members of first and second elastic sheets **332***a* and **332***b* so that the sheet members are disposed so as to overlap to form a sheet overlapping portion **332***c*. Moreover, the sheet overlapping portion **332***c* blocks a portion of the elastic sheet **332** which is opened when the conveying nozzle **611** is inserted.

The attaching portion **337** has such a cylindrical shape that the diameter of the inner circumferential surface decreases stepwise toward a container seal attached wall (serving as a seal attached portion) **336** to be described later. As illustrated in FIGS. **14** and **15**, the attaching portion **337** has the donut-shaped container seal attached wall **336** in which the diameter of the inner circumferential surface is smaller than the other portion in order to hold the elastic sheet **332** and the container seal **333**.

The donut-shaped container seal **333** is disposed so as to make contact with a wall surface which is on the front end side in relation to the container seal attached wall **336**. The container seal **333** is attached to the wall surface (first wall surface) on the front end side of the container seal attached wall **336** of the attaching portion **337** by an adhesive agent, a double-sided tape, or the like.

On the other hand, the elastic sheet **332** is attached to the attaching portion **337** in such a manner that a planar surface of the elastic sheet **332** having such a shape that is larger by an overlapping margin than a semi-circle is interposed between a wall surface (second wall surface) on the rear end side of the container seal attached wall **336** and the sheet stopper **335**. Specifically, the sheet stopper **335** is press-fitted to the attaching portion **337** so that the elastic sheet **332** is interposed between the inner circumferential surface of a portion of the attaching portion **337** that includes the nozzle insertion opening **331** and the wall surface on the rear end side of the container seal attached wall **336**. In this manner, the sheet stopper **335** can be attached to the attaching portion **337**, and the elastic sheet **332** that is interposed between the sheet stopper **335** and the attaching portion **337** can be held on the attaching portion **337**.

A method of holding the elastic sheet **332** to the attaching portion **337** is not limited to press-fitting, and an adhesive agent may be used.

Moreover, the following method may be used as a method of holding the elastic sheet **332** to the attaching portion **337**. That is, a convex portion may be provided on the sheet stopper **335** and a concave portion or a hole may be provided in the attaching portion **337**. Moreover, holding may be realized in such a manner that the convex portion of the sheet stopper **335** engages with the concave portion or hole of the attaching portion **337** with the elastic sheet **332** interposed. Further, a concave portion or a hole may be provided in the sheet stopper **335** and a convex portion may be provided on the attaching portion **337**.

As illustrated in FIGS. **14** and **15**, a plurality of nozzle shutter bumping ribs **337***a* is provided on the inner circumferential surface of a part of the attaching portion **337** in which the container seal **333** is disposed. As illustrated in FIGS. **14** and **15**, in a state where the container seal **333** is attached to the attaching portion **337**, an end surface on the front end side of the container seal **333** protrudes in the rotation axis direction further than the front end of the nozzle shutter bumping rib **337***a*. As illustrated in FIG. **13**, when the toner container **32** is attached to the toner replenishing device **60**, a nozzle shutter flange portion (bumping portion) **612***a* of the nozzle shutter **612** close to the toner replenishing device **60** bumps against the front end of the nozzle shutter bumping rib **337***a*. A front end surface of the container seal **333** protrudes further than the front end of the nozzle shutter bumping rib **337***a*. Thus, when the toner container **32** is attached to the toner replenishing device **60**, the nozzle shutter flange portion **612***a* makes contact with the container seal **333** and then bumps against the nozzle shutter bumping rib **337***a* while squeezing the container seal **333**. In this way, when the toner container **32** is attached to the toner replenishing device **60**, the container seal **333** is squeezed by the nozzle shutter flange portion **612***a*. As a result, it is possible to secure air-tightness around the conveying nozzle **611** of the nozzle insertion opening **331** during attachment and to prevent toner leakage.

In the toner container **32**, the container seal **333** which is an elastic member defines a front end surface of a portion in which the nozzle insertion opening **331** of the nozzle receiver **330** is open. Moreover, the nozzle shutter flange portion **612***a* which is a bumping portion of the nozzle shutter **612** which is a powder inlet opening and blocking member bumps against the nozzle shutter bumping rib **337***a* in a state where the container seal **333** is squeezed and compressed, described above. As a result, a surface of the nozzle shutter flange portion **612***a* opposite to a nozzle shutter spring receiving surface **612***f* makes close contact with the container seal **333**, and a toner leakage preventing function can be improved.

In the toner container **32**, a plurality of nozzle shutter bumping ribs **337***a* serving as a bumped portion. And the

nozzle shutter flange portion **612***a* serves as a bumping portion. The plurality of nozzle shutter bumping ribs **337***a* and the nozzle shutter flange portion **612***a* bump each other when the container seal **333** is compressed. A back side of the nozzle shutter spring receiving surface **612***f* of the nozzle shutter flange portion **612***a* biased by the nozzle shutter spring **613** bumps against the nozzle shutter bumping rib **337***a*, whereby the position in the rotation axis direction of the nozzle shutter **612** in relation to the toner container **32** is determined. As a result, a positional relation in the rotation axis direction between the nozzle shutter **612** and the front end surface of the container seal **333** and the front end surface of the front end opening **305** (the inner space of a cylindrical attaching portion **337** to be described later, disposed in the container opening **33***a*) is determined.

As illustrated in FIGS. **11** to **13**, when the toner container **32** is attached to the toner replenishing device **60**, the nozzle shutter **612** as a contacting member and the nozzle shutter spring **613** as a biasing member are accommodated in the front end opening **305** which is a columnar inner space.

Moreover, as will be described later, during attachment of the toner container **32**, the nozzle opening. **610** starts opening when the nozzle shutter flange portion **612***a* bumps against the nozzle shutter bumping rib **337***a* and the relative position of the nozzle shutter **612** to the toner container **32** is determined. On the other hand, during detachment of the toner container **32**, even when the conveying nozzle **611** starts being removed from the toner container **32**, the relative position of the nozzle shutter **612** to the toner container **32** does not change in a state where the nozzle opening **610** is opened. After the nozzle shutter **612** blocks the nozzle opening **610**, the nozzle shutter **612** starts being removed from the toner container **32** together with the conveying nozzle **611**. In a state where the nozzle shutter flange portion **612***a* bumps against the nozzle shutter bumping rib **337***a*, a portion of the conveying nozzle **611** where the nozzle opening **610** is provided is positioned sufficiently on the inner side of the toner container **32** than an inlet portion of the nozzle insertion opening **331**. Since the nozzle opening **610** is opened and closed in the state where it is positioned sufficiently on the inner side of the toner container **32**, it is possible to prevent toner leakage to the outside from the nozzle opening **610**.

As illustrated in FIGS. **14** and **15**, a step is provided in the middle in the rotation axis direction of the outer circumferential surface of the attaching portion **337** of the nozzle receiver **330** so that the outer diameter on the rear end side decreases. Moreover, as illustrated in FIG. **15**, the inner circumferential surface of the container opening **33***a* of the container body **33** has a shape that follows the outer circumferential surface of the attaching portion **337**, and a step is provided so that the inner diameter on the rear end side decreases. Moreover, the step on the outer circumferential surface of the attaching portion bumps against the entire area in the circumferential direction of the step on the inner circumferential surface of the container opening **33***a*. As a result, an axial tilt (a state where a central axis of the cylindrical attaching portion **337** tilts in relation to the central axis of the cylindrical container opening **33***a*) of the nozzle receiver **330** in relation to the container body **33** is prevented.

Next, the configuration of the container front end cover **34** will be described.

The container front end cover **34** of the toner container **32** is moved so as to slide on the container receiving portion **72** of FIG. **5** when the container front end cover **34** is attached to the toner replenishing device **60**. In FIG. **5**, with the axial direction of the container body **33** as the longitudinal direction, a groove extending from the insertion opening defining portion **71** to the cap portion **73** is provided immediately below the four toner containers **32**. A pair of slide guides **361** is provided on both side surfaces in the lower portion of the container front end cover **34** so as to allow sliding movement in a manner of being fitted to the groove. Specifically, a pair of slide rails is provided on the groove of the container receiving portion **72** so as to protrude from both side surfaces of the groove. The slide guides **361** form a slide groove **361***a* in parallel to the rotation axis of the container body **33** so as to be vertically interposed by the pair of slide rails. Further, the container front end cover **34** includes a container engaged portion **339** that engages with a replenishing device-side engaging member (container engaging member) **609** provided in the set cover **608** when the container front end cover **34** is attached to the toner replenishing device **60**.

Moreover, an IC tag (IC chip) **700** which is an information storage device that records data such as a use state of the toner container **32** is provided on the container front end cover **34**. Further, a color identifying rib **34***b* that prevents attachment of the toner container **32** to a set cover **608** corresponding to a color different from the color of toner stored in the toner container **32** is provided on the container front end cover **34**. As described above, when the slide guide **361** engages with the slide rail of the container receiving portion **72** during attachment, the posture of the container front end cover **34** on the toner replenishing device **60** is determined. Moreover, alignment of the container engaged portion **339** and the replenishing device-side engaging member **609** and alignment of the IC tag **700** to be described later and a body-side connector **800** can be performed smoothly.

Next, the toner replenishing device **60** will be described.

As illustrated in FIGS. **9** and **10**, the toner replenishing device **60** includes a nozzle holder **607** that fixes the conveying nozzle **611** to a body frame **602** of the copying machine **500**, and the set cover **608** is fixed to the nozzle holder **607**. Further, the falling path defining portion **64** that is disposed so as to communicate with the conveying nozzle **611** from the lower side of the conveying nozzle **611** so as to form a falling conveying path of toner is fixed to the nozzle holder **607**.

Moreover, as illustrated in FIGS. **11** to **13**, an oscillating spring **640** is disposed inside the falling path defining portion **64**.

The oscillating spring **640** has one end being engaged with the rotation shaft of the conveying screw **614** to move vertically with rotation of the conveying screw **614**. The oscillating spring **640** performs this vertical movement to scrape off the toner that stays and adheres near the inner wall surface of the falling path defining portion **64** which is a tubular member. In order to improve the effect of preventing clogging of the falling path defining portion **64**, it is desirable to dispose the oscillating spring **640** near the inner wall surface of the falling path defining portion **64**. In the configuration of the present embodiment, since the falling path defining portion **64** is a cylindrical member, the oscillating spring **640** (a spring member of which diameter is slightly smaller than the diameter of the inner wall of the falling path defining portion **64**) is an oscillating scraping member. When the cross-sectional shape of around slice of the falling path defining portion **64** is a shape other than a circular shape, the shape of the oscillating scraping member may be adjusted to comply with the cross-sectional shape of the falling path defining portion **64**.

Moreover, the container rotation driving unit **91** is fixed to the frame **602**. The container rotation driving unit **91** includes the driving motor **603** and the container driving output gear **601** and further includes a worm gear **603***a* that transmits rotational driving force of the driving motor **603** to the rota-

tion shaft of the container driving output gear **601**. A power transmission gear **604** is fixed to the rotation shaft of the container driving output gear **601** to mesh with the conveying screw gear **605** fixed to the rotation shaft of the conveying screw **614**. With such a configuration, when the driving motor **603** is rotated, the toner container **32** can be rotated by the container driving output gear **601** and the container gear **301**. Moreover, when the driving motor **603** is rotated, the conveying screw **614** can be rotated by the power transmission gear **604** and the conveying screw gear **605**. That is, by rotation driving the driving motor **603**, the toner container **32** as well as the conveying screw **614** can be rotated.

A clutch may be provided in the power transmission path between the driving motor **603** and the container gear **301** and the power transmission path between the driving motor **603** and the conveying screw gear **605**. By providing such a clutch, a configuration in which only one of the toner container **32** and the conveying screw **614** is rotated when the driving motor **603** is rotated can be realized.

Next, the conveying nozzle **611** of the toner replenishing device **60** will be described.

FIG. **16** is a cross-sectional view illustrating the nozzle shutter **612**. Moreover, FIG. **17** is a perspective view illustrating the nozzle shutter **612** when seen from the side (nozzle front end side) on which the toner container **32** is attached. FIG. **18** is a cross-sectional view illustrating the vicinity of the conveying nozzle **611** of the toner replenishing device **60**, and FIG. **19** is a perspective cross-sectional view illustrating the vicinity of the nozzle opening **610** of the conveying nozzle **611**. In FIGS. **18** and **19**, the conveying screw **614** disposed in the conveying nozzle **611** is not depicted. Moreover, the conveying nozzle **611** has a sheet member guide **611***a* to be described later that is disposed in an end that faces the toner container, on the side opposite to the base thereof. The sheet member guide **611***a* will be described later.

A container setting portion **615** is provided in the base of the conveying nozzle **611**. And the front end of the container opening **33***a* is fitted to the container setting portion **615** in a state where the toner container **32** is attached to the toner replenishing device **60**. The container setting portion **615** has a cylindrical shape and the inner circumferential surface (container-setting-portion inner circumferential surface **615***a*) is fitted to the outer circumferential surface of the cylindrical container opening **33***a* in a slidable state. With this fitting, the position of the toner container **32** in relation to the toner replenishing device **60** in a planar direction orthogonal to the rotation axis of the toner container **32** is determined. Moreover, during rotation of the toner container **32**, the cylindrical container opening **33***a* functions as a rotation axis portion and the container setting portion **615** functions as a bearing. In this case, the position at which the container opening **33***a* makes a slidable contact with the container setting portion **615** and the toner container **32** is aligned with respect to the toner replenishing device **60** is indicated by "α" in FIG. **13**.

As illustrated in FIG. **16** and other figures, the nozzle shutter **612** includes the nozzle shutter flange portion **612***a* and a nozzle shutter cylinder portion **612***e*. A first shutter inner circumference rib **612***b* is provided on a portion of the inner circumferential surface near the nozzle front end of the nozzle shutter cylinder portion **612***e*. On the other hand, a second shutter inner circumference rib **612***c* and a third shutter inner circumference rib **612***d* are provided on the entire inner circumferential surface near the nozzle base end of the nozzle shutter cylinder portion **612***e*.

The length in the circumferential direction of the inner circumferential surface of the first shutter inner circumference rib **612***b* is set such that the first shutter inner circumference rib **612***b* can be fitted to the nozzle opening **610** in a state where the nozzle shutter **612** is attached to the conveying nozzle **611**.

As illustrated in FIGS. **11** and **18**, the nozzle base end of the nozzle shutter spring **613** bumps against a container-setting-portion end surface **615***b* which is an end surface of the container setting portion **615**. Moreover, the nozzle front end of the nozzle shutter spring **613** bumps against the nozzle shutter spring receiving surface **612***f* of the nozzle shutter flange portion **612***a*. In this case, since the nozzle shutter spring **613** is compressed more than its natural length, the nozzle shutter **612** receives biasing force in the removal direction (the left direction in FIG. **18**) from the nozzle front end side. However, the first shutter inner circumference rib **612***b* bumps against an edge, that is, an upper portion of a nozzle-front-end-side inner wall surface **611***b* which is an inner wall surface of the sheet member guide **611***a* of the conveying nozzle **611**, on the nozzle front end side of the nozzle opening **610**. Due to this, the nozzle shutter **612** is prevented from moving in the removal direction from the conveying nozzle **611** further than the state illustrated in FIGS. **18** and **19**. With the bumping of the first shutter inner circumference rib **612***b* and the biasing force of the nozzle shutter spring **613**, the position in the rotation axis direction of the nozzle shutter **612** in relation to the conveying nozzle **611** is determined.

A first inner-circumference-rib front end **612***g* which is an end in the circumferential direction of the first shutter inner circumference rib **612***b* has such a shape that it bumps against a nozzle-opening transversal edge **611***s* which is an edge in the transverse direction of the nozzle opening **610**. This shape allows the first inner-circumference-rib front end **612***g* to bump against the nozzle-opening transversal edge **611***s* when the nozzle shutter **612** rotates in the direction indicated by arrow A in FIG. **19**.

When the toner container **32** rotates, force that allows the nozzle shutter **612** to rotate in the direction indicated by arrow A in FIG. **19** acts on the nozzle shutter **612** of which the outer circumferential surface of the nozzle shutter cylinder portion **612***e* makes contact with the inner circumferential surface of the container seal **333** attached to the toner container **32**. In this case, when the nozzle shutter **612** rotates in relation to the conveying nozzle **611** and the first shutter inner circumference rib **612***b* is separated from the nozzle opening **610**, the following problem may occur. That is, when the toner replenishing device **60** is detached from the toner container **32**, the nozzle shutter **612** may be removed from the conveying nozzle **611** by the biasing force of the nozzle shutter spring **613**.

Moreover, depending on the elasticity of the nozzle shutter **612**, the first shutter inner circumference rib **612***b* separated from the nozzle opening **610** may tightly fasten the outer circumferential surface of the conveying nozzle **611** to make the nozzle shutter **612** immovable in relation to the conveying nozzle **611**. In any case, when the toner container **32** is detached from the toner replenishing device **60**, the nozzle opening **610** is open, which can cause toner leakage.

In contrast, in the toner replenishing device **60** of the present embodiment, when the nozzle shutter **612** rotates in the direction indicated by arrow A in FIG. **19**, the first inner-circumference-rib front end **612***g* bumps against the nozzle-opening transversal edge **611***s*. As a result, the nozzle shutter **612** is prevented from rotating in relation to the conveying nozzle **611** further from the state illustrated in FIG. **19**.

Moreover, the inner diameter of the second and third shutter inner circumference ribs **612***c* and **612***d* is slightly smaller than the outer diameter of the cylindrical conveying nozzle **611**. Moreover, the second and third shutter inner circumfer-

ence ribs **612***c* and **612***d* are elastically deformed so that the nozzle shutter **612** can be attached to the conveying nozzle **611**. In a state where the two ribs (**612***c* and **612***d*) having a smaller inner diameter than the outer diameter of the conveying nozzle **611**, since the inner circumferential surface of the nozzle shutter **612** makes contact with the outer circumferential surface of the conveying nozzle **611**, it is possible to enhance air-tightness between the inner circumferential surface of the nozzle shutter **612** and the outer circumferential surface of the conveying nozzle **611**. Thus, it is possible to prevent toner leakage between the nozzle shutter **612** and the conveying nozzle **611**.

Moreover, the toner replenishing device **60** of the present embodiment uses a conical spring as the nozzle shutter spring **613**. A conical spring can allow at least a portion of neighboring coils to overlap when the spring is compressed, and it is possible to shorten the length in the rotation axis direction in the compressed state. Thus, it is possible to decrease the space in the rotation axis direction of the nozzle shutter spring **613** in the compressed state.

Next, the process of attaching the toner container **32** to the toner replenishing device **60** will be described.

First, as illustrated in FIG. **7**, the cap **370** is detached from the toner container **32** having the cap **370** attached thereto to create a state illustrated in FIG. **6**.

Subsequently, the toner container **32** is moved toward the toner replenishing device **60** as indicated by arrow Q in FIGS. **9** and **11** so that the conveying nozzle **611** is inserted into the nozzle insertion opening **331** and the sheet member guide **611***a* makes contact with the front end-side surface of the elastic sheet **332**.

When the toner container **32** is moved further toward the toner replenishing device **60** so that the conveying nozzle **611** is inserted in such a manner to expand the sheet overlapping portion **332***c* positioned at the center of the elastic sheet **332**. Specifically, as illustrated in FIG. **12**, the sheet member guide **611***a* of the conveying nozzle **611** presses the elastic sheet **332** to elastically deform the elastic sheet **332**. With this elastic deformation, the sheet overlapping portion **332***c* of the two elastic sheets **332** is expanded, and the sheet member guide **611***a* of the conveying nozzle **611** passes through a portion of the nozzle insertion opening **331** blocked by the elastic sheet **332**. In this case, the nozzle shutter cylinder portion **612***e* of the nozzle shutter **612** located closer to the nozzle front end side than the nozzle shutter flange portion **612***a* is inserted into the nozzle insertion opening **331** together with the conveying nozzle **611**.

When the toner container **32** is moved further toward the toner replenishing device **60**, the nozzle shutter cylinder portion **612***e* and the conveying nozzle **611** are inserted deeper into the nozzle insertion opening **331**. As a result, the surface of the nozzle shutter flange portion **612***a* opposite to the nozzle shutter spring receiving surface **612***f* makes contact with the front end surface of the container seal **333**.

When the toner container **32** is moved further toward the toner replenishing device **60** from this state, the toner container **32** bumps into the nozzle shutter bumping rib **337***a* while slightly squeezing the container seal **333**. As a result, the relative position in the rotation axis direction of the nozzle shutter **612** to the toner container **32** is attached.

When the toner container **32** is moved further toward the toner replenishing device **60**, the conveying nozzle **611** is inserted further into the toner container **32**. In this case, the nozzle shutter **612** bumping against the nozzle shutter bumping rib **337***a* is pushed back toward the nozzle base side in relation to the conveying nozzle **611**. As a result, the nozzle shutter spring **613** is contracted and the relative position of the nozzle shutter **612** in relation to the conveying nozzle **611** moves toward the nozzle base side. With the movement of the relative position, the nozzle opening **610** covered by the nozzle shutter **612** is exposed inside the container body **33** and the container body **33** and the conveying nozzle **611** communicate with each other.

In the state where the conveying nozzle **611** is inserted into the nozzle insertion opening **331**, due to the biasing force of the nozzle shutter spring **613** in the contracted state, force that causes the toner container **32** to be pushed backward (the direction opposite to the arrow Q in the figure) acts on the toner replenishing device **60**. However, when the toner container **32** is attached to the toner replenishing device **60**, the container engaged portion **339** resists against this force to move the toner container **32** toward the toner replenishing device **60** up to such a position that the container engaged portion **339** engages with the replenishing device-side engaging member **609**. As a result, the biasing force of the nozzle shutter spring **613** and the hooking force of the container engaged portion **339** in relation to the replenishing device-side engaging member **609** are applied. Due to the action of the biasing force and the hooking force, the position in the rotation axis direction of the toner container **32** in relation to the toner replenishing device **60** is determined in the state illustrated in FIGS. **10** and **13**.

As illustrated in FIG. **9**, the container engaged portion **339** for determining the position in the axial direction of the toner container **32** in relation to the toner replenishing device **60** is provided on the outer circumferential surface of the container front end cover **34**. When the toner container **32** is attached to the toner replenishing device **60**, the replenishing device-side engaging members **609** provided on the set cover **608** engage with the container engaged portions **339**.

The container engaged portion **339** includes a guide projection **339***a*, a guide groove **339***b*, a step portion **339***c*, and an engaged opening **339***d*. Two sets of container engaged portions **339** composed of the guide projection **339***a*, the guide groove **339***b*, the step portion **339***c*, and the engaged opening **339***d* are disposed in the container front end cover **34**. Specifically, when the toner container **32** is seen from the front side, the container engaged portions **339** are disposed in pair on both sides of the container front end cover **34** with respect to a straight line passing through the nozzle insertion opening **331**.

Each guide projection **339***a* is provided on a vertical planar surface that is orthogonal to the longitudinal direction of the toner container **32** on the container front end side of the container front end cover **34** and that passes the center of the rotation axis of the container body **33**. The guide projections **339***a* have slope surfaces that make contact with the replenishing device-side engaging members **609** during attachment of the toner container **32** and that are adjoined to the guide grooves **339***b* so that the replenishing device-side engaging members **609** can be guided toward the guide grooves **339***b*. This slope surface has such a shape that a container front end side is on the inner side than the outer circumferential surface of the container front end cover **34** and is provided so as to be adjoined to the guide groove **339***b*. The guide grooves **339***b* are grooves provided on the outer circumferential surface of the container front end cover **34** and are slid surfaces on which the replenishing device-side engaging members **609** slide.

A width of the groove of each guide groove **339***b* in the direction orthogonal to the longitudinal direction is slightly larger than the width in the same direction of the replenishing device-side engaging member **609** and is set such that the replenishing device-side engaging member **609** being guided does not fall off from the guide groove **339***b*.

Moreover, each guide groove **339***b* is provided so as to extend in the longitudinal direction, and the step portion **339***c* having the same height as the outer circumferential surface of the container front end cover **34** is adjoined to an end on the container rear end side thereof. In other words, an approximately 1-mm wide outer circumferential surface of the container front end cover **34** is disposed between each guide groove **339***b* and each engaged opening **339***d*. When each replenishing device-side engaging member **609** climbs over the step portion **339***c* to enter into and engage with (fall into) the engaged openings **339***d*, the toner container **32** is set (latched) to the toner replenishing device **60**. This state is the attachment state of the toner container **32**.

The engaged openings **339***d* are not limited to through-holes, the engaged openings **339***d* may be bottomed holes having such a depth that the replenishing device-side engaging members **609** can engage therewith. In other words, the engaged openings **339***d* may be concave portions of which the side close to the circumferential surface of the container body **33** is blocked unless the holes do not interrupt the replenishing device-side engaging members **609** from moving to engage with the engaged openings **339***d*.

The toner container **32** has a configuration in which the nozzle insertion opening **331** is positioned at the center of a line that connects the two container engaged portions **339** on an imaginary plane orthogonal to the rotation axis. The following problem may occur unless the nozzle insertion opening **331** is positioned on the line that connects the two container engaged portions **339**. That is, the biasing force of the nozzle shutter spring **613** acts on the plurality of nozzle shutter bumping ribs **337***a* arranged at an equal distance from the center of the nozzle insertion opening **331**. Due to this biasing force, a moment of force that rotates the toner container **32** about the line with the distance from the line to the center of the nozzle insertion opening **331** as the arm of the moment acts. Due to the action of the moment of this force, the toner container **32** may tilt in relation to the toner replenishing device **60**. In this case, the attachment load of the toner container **32** increases and a load is applied to the nozzle receiver **330**.

In particular, if the toner container **32** is a new one in which toner is stored sufficiently, when the conveying nozzle **611** protruding in the horizontal direction is pushed from the rear end side of the toner container **32** so as to be inserted therein, a moment of force that rotates the toner container **32** with the weight of toner added acts. As a result, a load may be applied to the nozzle receiver **330** in which the conveying nozzle **611** is inserted, and in a worst case, the nozzle receiver **330** may be deformed or broken.

In contrast, in the toner container **32** of the present embodiment, the center of the nozzle insertion opening **331** is positioned on the line that connects the two container engaged portions **339**. Thus, it is possible to prevent the toner container **32** from tilting in relation to the toner replenishing device **60** by the biasing force of the nozzle shutter spring **613** acting at the central position of the nozzle insertion opening **331**.

As illustrated in FIG. **13**, a configuration in which a circular end surface of the container opening **33***a* which is the front end of the toner container **32** does not make contact with the container-setting-portion end surface **615***b* in a state where the toner container **32** is attached to the toner replenishing device **60** is realized. This is because of the following reasons. A configuration in which the circular end surface of the container opening **33***a* makes contact with the container-setting-portion end surface **615***b* will be taken into consideration. In such a configuration, the circular end surface of the container opening **33***a* may bump against the container-setting-portion end surface **615***b* of the container setting portion **615** before the engaged opening **339***d* of the container engaged portion **339** is engaged to the replenishing device-side engaging member **609**. When this bumping occurs, the toner container **32** cannot be moved further toward the toner replenishing device **60**, and the positioning in the rotation axis direction of the toner container **32** in relation to the toner replenishing device **60** cannot be realized. To prevent this, a small gap is provided between the circular end surface of the container opening **33***a* and the container-setting-portion end surface **615***b* of the container setting portion **615** in a state where the toner container **32** is attached to the toner replenishing device **60**.

Moreover, in a state where the position in the rotation axis direction of the toner container **32** in relation to the toner replenishing device **60** is determined, the outer circumferential surface of the container opening **33***a* is slidably fitted to the container-setting-portion inner circumferential surface **615***a*. Thus, as described above, the position of the toner container **32** in relation to the toner replenishing device **60** in the planar direction orthogonal to the rotation axis is determined. As a result, the attachment of the toner container **32** to the toner replenishing device **60** is completed.

In a state where attachment of the toner container **32** is completed, when the driving motor **603** is rotation driven, the container body **33** of the toner container **32** and the conveying screw **614** in the conveying nozzle **611** rotate.

When the container body **33** rotates, the toner in the container body **33** is conveyed to the front end side of the container body **33** by the spiral projection **302**. The toner having reached the scooping portion **304** with the conveying is scooped up to above the nozzle opening **610** by the movement of the scooping portion **304** due to rotation of the container body **33**. When the toner scooped up to above the nozzle opening **610** falls into the nozzle opening **610**, the toner is supplied into the conveying nozzle **611**. The toner supplied into the conveying nozzle **611** is conveyed by the conveying screw **614** and is replenished into the developing device **50** through the falling path defining portion **64**.

Here, a configuration in which toner is scooped upward by the scooping portion **304** of the container body **33** and falls into the nozzle opening **610**, and the toner is supplied into the conveying nozzle **611** will be described in detail.

First, the problem associated with the time of supplying toner from the toner container **32** to the conveying nozzle **611** will be described. In a state where toner is sufficient in the container body **33**, for example, immediately after the toner container **32** is attached to the toner replenishing device **60**, an overflowably large amount of toner is continuously supplied to the nozzle opening **610** of the conveying nozzle **611**. Thus, the extension portion **335***a* is rotated to cross above the nozzle opening **610** to drop the overflowing toner, and the conveying screw **614** is controlled to rotate intermittently. In this way, it is possible to replenish a desired amount of toner to the developing device **50**.

On the other hand, when the amount of toner in the container body **33** decreases with the elapse of use time, the proportion of the amount of toner leaking through a gap between the end on the rotation center side of the scooping wall surface **304***f* and the conveying nozzle **611** to the amount of toner moving from the scooping portion **304** to the nozzle opening **610** increases. As a result, the amount of toner that can be replenished to the developing device **50** decreases. When the amount of toner that can be replenished to the developing device **50** decreases, since the toner density of the developer G in the developing device **50** becomes unstable, the need to replace the toner container **32** arises. In this state,

since a large amount of toner remains in the container body **33**, a problem that large amount of toner remains in the toner container **32** during replacement occurs.

FIG. **30** is a cross-sectional view illustrating a cross-section orthogonal to the rotation axis at which the position in the rotation axis direction of the container body **33** attached to the nozzle receiver **330** is at the position of the scooping portion **304**.

The present invention includes the following inventions. That is, as illustrated in FIG. **30**, in the toner container **32**, the outer circumferential surface of the extension portion **335***a* faces the inner wall surface of the container body **33** closer to the upstream side than the convex portion **304***h* in a state where the nozzle receiver **330** is attached to the container body **33**. Specifically, an inner wall surface on the upstream side in the rotation direction of the container body **33** among the inner wall surfaces divided by the convex portion **304***h* corresponding to a ridge line of a bulging portion that bulges toward the inner side of the container body **33** faces the outer circumferential surface of the extension portion **335***a*. With this configuration, the following advantages are obtained. That is, the inner wall surface on the downstream side in the rotation direction among the inner wall surfaces divided by the convex portion **304***h* of the container body **33** when seen from the surface orthogonal to the rotation axis is the scooping wall surface **304***f*. With rotation of the container body **33**, the scooping wall surface **304***f* can be positioned relatively above an extension-portion opening **335***b* which is a void region where the pair of extension portions **335***a* of the sheet stopper **335** is not present. The nozzle opening **610** is always open upward. Thus, the extension-portion opening **335***b* is also positioned above at the point in time when the scooping portion **304** is positioned above with rotation of the toner container **32**, and the toner scooped up by the scooping portion **304** passes through the extension-portion opening **335***b* and is supplied to the nozzle opening **610**.

Further, as illustrated in FIG. **30**, an extension-portion downstream end surface **335***c* which is an end surface on the downstream side in the rotation direction of the extension portion **335***a* is disposed at a position near the convex portion **304***h* protruding toward the center of rotation of the container body **33**. As a result, the toner flowing downward along the scooping wall surface **304***f* falls on the extension-portion downstream end surface **335***c* and is supplied to the nozzle opening **610**. In other words, the extension-portion downstream end surface **335***c* has a function of relaying the toner received from the scooping wall surface **304***f* to the nozzle opening **610**.

Next, the relaying function of the extension portion **335***a* of the toner container **32** will be described.

FIG. **31** is a cross-sectional view illustrating the container body **33** in an E-E cross-section cut at the end surface of the bearing of the conveying screw **614** on the front end side of the conveying nozzle **611** in FIG. **13**.

FIG. **32** illustrates the E-E cross-section in FIG. **13**. FIG. **32**(*a*) is a schematic functional diagram of a comparative example and is a diagram illustrating a configuration in which the extension portion **335***a* does not function as a relaying means. FIG. **32**(*b*) is a schematic functional diagram of FIG. **31** and is a diagram illustrating a configuration in which the extension portion **335***a* functions as a relaying means.

First, a conventional problem will be described. As in JP-A No. 2009-276659, in a configuration in which it is possible to control the amount of toner conveyed in a conveying nozzle, toner can be conveyed stably if a sufficient amount of toner is present near the opening of the conveying nozzle. However, when the amount of toner in the toner container decreases, the amount of toner conveyed may decrease and toner may not be conveyed stably. This is because, although it is possible to move toner to the vicinity of the inlet by the spiral projection provided inside the toner container, the toner may slip off before reaching the opening of the conveying nozzle and the amount of toner entering the conveying nozzle decreases. When the amount of toner conveyed decreases and it is impossible to convey toner stably, since the toner density of the developer in the developing device becomes unstable, the need to replace the toner container arises. In this state, since a large amount of toner remains in the container body, a problem that a large amount of toner remains in the toner container during replacement occurs.

In FIG. **13**, the conveying nozzle (conveying nozzle) **611** is inserted in the nozzle receiver (nozzle insertion portion) **330** in the container body **33**. The nozzle opening (powder inlet) **610** of the conveying nozzle **611** inserted in the nozzle receiver **330** is open, and a state where toner can be conveyed into the toner replenishing device **60** is created.

A portion of the scooping portion **304** overlaps with the nozzle opening **610** in the longitudinal direction of the toner container **32** and another portion corresponds to the inner wall surface of the container body **33** located closer to the rear end side than the nozzle opening **610**. Specifically, the scooping portion **304** includes the convex portion **304***h* that corresponds to the ridge line in which the inner wall of the container body **33** bulges in the rotation axis direction and the scooping wall surface **304***f* which is a wall surface on the downstream side in the container rotation direction among the inner wall surfaces divided by the ridge line (see FIG. **31**).

As illustrated in FIG. **31**, the ridge line of the convex portion **304***h* has a gently-sloping mounting shape because the container body **33** is formed by blow-molding. In FIG. **13** and other figures, the convex portion **304***h* is depicted as a curved line for convenience's sake in order to distinguish the scooping wall surface **304***f*. The scooping wall surface **304***f* is a region depicted by a grid pattern as illustrated in FIG. **13** and includes a pair of slope surfaces that connects the convex portion **304***h* and the inner circumferential surface of the container body **33** in point-symmetry about the rotation axis of the container body **33** as illustrated in FIG. **31**. At the position of the E-E cross-section, since the extension direction of the wall surface on the upstream side in the container rotation direction among the inner wall surfaces divided by the ridge line is approximately identical to the cutting direction of the E-E cross-section, the wall surface has such a thickness as illustrated in FIG. **31**. The convex portion **304***h* is also at the position where it seems to have its thickness.

In FIG. **31**, the nozzle opening **610** that is open upward is disposed in the tubular conveying nozzle **611**. The pair of extension portion **335***a* attached to the container body **33** is disposed between the conveying nozzle **611** and the convex portion **304***h* and rotates integrally with the scooping wall surface **304***f* with rotation of the container body **33**. At the position (the position on the front end side of the conveying nozzle **611** and on the end surface of the bearing of the conveying screw **614**) of the E-E cross-section, the convex portion **304***h* and the extension portion **335***a* face each other. Moreover, the scooping wall surface **304***f*, the extension-portion downstream end surface **335***c* of the extension portion **335***a*, and the nozzle-opening transversal edge **611***s* on the upstream side in the rotation direction of the nozzle opening **610** are disposed when seen from the downstream side in the container rotation direction.

Similarly to the scooping action described with reference to FIG. **30**, the toner is also moved as indicated by arrow T**1** toward the nozzle opening **610** which is an opening of the

conveying nozzle **611** by the scooping portion **304** configurated by the scooping wall surface **304***f* of the container body **33** of FIG. **31**. In this case, the outer circumferential surface and the extension-portion downstream end surface **335***c* of the extension portion **335***a* function as a toner relaying portion that relays toner from the scooping portion **304** to the nozzle opening **610**.

As illustrated in FIG. **31**, the inner diameter of the extension portion **335***a* is larger than the outer diameter of the conveying nozzle **611**. Due to this, the conveying nozzle **611** having passed through a region where it makes contact with the container seal **333** is prevented from making contact with the inner circumferential surface of the extension portion **335***a*, and a load is rarely applied when the conveying nozzle **611** is inserted into the container body. Since the container seal **333** having a smaller inner diameter than the outer diameter of the conveying nozzle **611** is provided in the nozzle receiver **330**, the toner in the container body **33** is prevented from leaking outside the container body **33** along the outer circumferential surface of the conveying nozzle **611**. As a result, it is possible to prevent leakage of toner along a path other than a toner conveying path in which toner is conveyed from the container body **33** toward the developing device **50** through the conveying nozzle **611**.

Details of the relaying function will be described with reference to the schematic diagrams of FIG. **32**.

FIG. **32**(*a*) illustrates the flow of toner inside the container body **33** when the extension portion **335***a* is disposed so as not to have the relaying function. With rotation of the container body **33** in the direction indicated by arrow A in the figure, the toner scooped upward by the scooping wall surface **304***f* along the circumferential direction of the container body **33** flows toward the nozzle opening **610** due to gravity (see arrow T**1**). However, some toner may leak from the gap between the conveying nozzle **611** and the convex portion **304***h* (the convex portion protruding toward the center of rotation of the scooping wall surface **304***f*) (see arrow T**2**).

More specifically, the state of FIG. **32**(*a*) is a state where the scooping wall surface **304***f* has not come sufficiently up to the upper side and the convex portion **304***h* is near, the 9 o'clock position of a clock. In this case, the upstream-side nozzle-opening transversal edge **611***s*, the convex portion **304***h* of the scooping wall surface **304***f*, and the downstream-side end surface of the extension portion **335***a* are arranged in that order when seen from the downstream side in the rotation direction of the container body **33**. In such a state, the end surface of the intermediate extension portion **335***a* is always later than the convex portion **304***h* of the scooping wall surface **304***f* that tries to relay toner and the toner relaying function cannot be obtained. Due to this delay, some toner leaks from the gap provided between the conveying nozzle **611**, the convex portion **304***h*, and the extension portion **335***a*. As a result, a problem that the replenishing speed becomes unstable and the amount of toner remaining in the container body **33** during replacement of the toner container **32** increases occurs.

FIG. **32**(*b*) illustrates the flow of toner inside the container body **33** having the extension portion **335***a* that functions as a relaying means.

The flow of toner until the toner scooped along the circumferential direction of the container body **33** by the scooping wall surface **304***f* flows toward the nozzle opening **610** due to gravity with rotation of the container body **33** in the direction indicated by arrow A in the figure is the same as the configuration illustrated in FIG. **32**(*a*). However, in the configuration illustrated in FIG. **32**(*b*), the extension portion **335***a* is disposed so as to block the gap between the conveying nozzle **611** and the convex portion **304***h* (the convex portion protruding toward the center of rotation of the scooping wall surface **304***f*). As a result, the extension-portion downstream end surface **335***c* of the extension portion **335***a* and the convex portion **304***h* of the scooping portion **304** are arranged in that order when seen from the downstream side in the rotation direction of the container body **33**.

Due to such an arrangement, the flow of toner as indicated by arrow T**2** in FIG. **32**(*a*) is suppressed, and the pumped toner enters into the nozzle opening **610** efficiently. Due to this, even when the amount of toner in the container body **33** decreases, the replenishing speed is stable and the amount of toner remaining in the container body **33** during replacement of the toner container **32** can be reduced. Moreover, since the amount of toner remaining in the container body **33** during replacement can be reduced, it is possible to reduce a running cost, improve cost performance, and reduce the amount of wasted toner to reduce an adverse effect on environment.

The force that causes the gap between the conveying nozzle **611** and the convex portion **304***h* to be blocked does not strong enough to allow the extension portion **335***a* and the convex portion **304***h* to make close contact with each other. However, a small gap (approximately 0.3 mm to 1 mm) may be provided between the extension portion **335***a* and the convex portion **304***h* so that toner is present in the convex portion **304***h* on the lower side of FIG. **32**(*b*) if the leakage of toner as indicated by arrow T**2** can be prevented. This is because a smaller gap may be clogged with toner to play the role of a seal by the operation when a large amount of toner is present at the start of toner replenishment. Moreover, since the scooping wall surface **304***f* is formed by blow-molding which cannot provide higher dimensional accuracy than injection molding, it is difficult to attain perfect close-contact, and it is desirable to have a small gap from the perspective of mass-productivity.

FIG. **33** is a graph illustrating the relation between the amount of toner remaining in a container and the replenishing speed (the amount of toner replenished per unit time) of the example (the configuration illustrated in FIGS. **31** and **32**(*b*)) and the comparative example (the configuration illustrated in FIG. **32**(*a*)).

It can be understood from FIG. **33** that the example maintains a stable replenishing speed even when the amount of toner remaining in the container decreases whereas the comparative example shows a decrease in the replenishing speed when the amount of toner remaining in the container. This is because in the comparative example without the relaying member, toner passes (slides off) through a gap provided between an end on the center of rotation of the scooping wall surface **304***f* which is a portion of the container body **33** and the conveying nozzle **611**. Thus, when the amount of remaining toner is small, a sufficient amount of toner cannot reach the nozzle opening **610**, the amount of toner supplied to the nozzle opening **610** cannot be maintained, and the replenishing speed decreases.

The toner container **32** of the example illustrated in FIGS. **13**, **31**, and **32**(*b*) includes the following inventions. That is, two scooping wall surfaces **304***f* are provided in the container body **33**, and two relaying members (the extension portions **335***a*) are provided at the positions corresponding to the scooping wall surfaces **304***f*. It is effective to provide the same number of relaying members as the number of scooping portions **304** such that three relaying members are provided when three scooping wall surfaces **304***f* are provided in the container body **33**. Similarly, it is also effective to provide the same number of relaying members as the number of scooping

portions **304** when four or more scooping portions **304** are provided in the container body **33**.

Naturally, some of a plurality of extension portions **335***a* may correspond to the scooping wall surfaces **304***f* as the relaying members. For example, only one of two extension portions **335***a* may be used as the relaying member, and only one scooping wall surface **304***f* may be provided in the container body **33** so as to correspond to the extension portion **335***a*.

In the above configuration, a configuration in which the toner container **32** and the conveying screw **614** are rotated simultaneously has been described. As the timings for rotating these components, the toner container **32** may be rotation driven first at the start of toner replenishment and the conveying screw **614** may be rotated subsequently after a predetermined period. Moreover, the toner container **32** may be stopped first at the stopping of toner replenishment and the conveying screw **614** may be stopped subsequently after a predetermined period. FIG. **20** illustrates the timing chart of such a rotation timing configuration.

In the rotation timing configuration illustrated in FIG. **20**, the toner container **32** starts rotation driving earlier than the conveying screw **614** at the start of toner replenishment. Thus, the conveying screw **614** can start rotation driving in a state where toner is filled near the nozzle opening **610** of the conveying nozzle **611**. Due to this, since the amount of toner conveyed by one rotation of the conveying screw **614** becomes stable from the start of rotation driving of the conveying screw **614**, the stability of the amount of toner replenished is improved.

Moreover, in the rotation timing configuration illustrated in FIG. **20**, the toner container **32** stops rotation driving before the conveying screw **614** in the conveying nozzle **611** stops rotation driving at the stopping of toner replenishment. Due to such a rotation timing configuration, toner is continuously conveyed by the conveying screw **614** in a state where the supply of new toner to the nozzle opening **610** is stopped, and the conveying screw **614** stops rotating after a predetermined period. Due to this, the toner T present near the nozzle opening **610** of the conveying nozzle **611** when the toner container **32** stops rotation driving can be conveyed toward the falling path defining portion **64** by the conveying screw **614**. As a result, the amount of toner T remaining in a state of being carried on the conveying nozzle **611** near the nozzle opening **610** can be reduced. After that, when the toner container **32** is removed from the device body, since the amount of toner on the conveying nozzle **611** is small, the conveying nozzle **611** can be cleaned easily by the elastic sheet **332** and the container seal **333** provided in the nozzle receiver **330**. Thus, scattering and falling toner accompanied by attachment and detachment of the toner container **32** to and from the device body can be prevented.

Such a configuration in which the toner container **32** and the conveying screw **614** rotate at different points in time can be easily realized by using independent driving sources for rotation driving the respective components.

Moreover, when the same driving source is use, such a configuration can be realized by providing a clutch. By using the same driving source, the configuration in which the two components rotate at different points in time can be realized at a low cost.

Moreover, it is preferable that even after the toner container **32** stops rotation driving, the conveying screw **614** stops rotation driving after the conveying screw **614** is rotated at least by an amount corresponding to the amount of conveying that corresponding to the width in the longitudinal direction of the nozzle opening **610** of the conveying nozzle **611**. By doing so, the toner T present near the nozzle opening **610** of the conveying nozzle **611** can be conveyed to a position closer to the falling path defining portion **64** than the position facing the nozzle opening **610**. With such conveying, the toner scattering and falling when the toner container **32** is detached from the toner replenishing device **60** can be prevented more reliably.

Moreover, it is preferable that even after the toner container **32** stops rotation driving, the conveying screw **614** starts rotation driving after the toner container **32** is rotation driven at least by an amount corresponding to such an amount of conveying that the nozzle opening **610** of the conveying nozzle **611** is filled with the toner T. By doing so, the stability of the amount of toner replenished is improved further.

Further, as described above, the position at which the container opening **33***a* makes slidable contact with the container setting portion **615** and the position of the toner container **32** in relation to the toner replenishing device **60** is determined is indicated by "α" in FIG. **13**. Here, the position "α" in FIG. **13** is not limited to the configuration where the position has the functions of both a sliding portion and a positioning portion but may have any one of the functions of the sliding portion and the positioning portion.

The toner container **32** of the present embodiment includes the nozzle receiver **330** that is disposed in the opening of the container body **33** so as to provide the nozzle insertion opening **331**. The nozzle insertion opening **331** is a portion in which the conveying nozzle **611** having the nozzle opening **610** serving as a powder inlet is inserted.

Moreover, the elastic sheet **332** included in the toner container **32** is attached to the nozzle receiver **330** and is elastically deformed in response to operation of the conveying nozzle **611** being inserted in the nozzle receiver **330** to thereby open the nozzle insertion opening **331**. Moreover, the elastic sheet **332** restores its original shape in response to operation of the conveying nozzle **611** being removed from the nozzle receiver **330** to thereby block a portion of the elastic sheet **332** expanded by the conveying nozzle **611**. That is, the nozzle receiver **330** includes the elastic sheet **332** as an opening and blocking member that opens and blocks the nozzle insertion opening **331** in response to operation of inserting or pulling the conveying nozzle **611** into or from the nozzle receiver **330**. Due to such a configuration, the toner container **32** can maintain a state where the nozzle insertion opening. **331** is blocked until the conveying nozzle **611** is inserted and can prevent leakage or scattering of toner in a state before the toner container **32** is attached to the toner replenishing device **60**.

Further, as illustrated in FIGS. **9** and **11**, the nozzle insertion opening **331** of the toner container **32** is provided in a portion, that is, a bottom portion of a columnar void portion defined by the cylindrical front end opening **305**, closer to the container inner side (the rear end side) than the front end of the front end opening **305**. Due to such a configuration, it is possible to suppress toner from adhering to the outer circumferential surface of the container opening **33***a* and adhering to the container-setting-portion inner circumferential surface **615***a*.

If toner adheres to the outer circumferential surface of the container opening **33***a*, when the same toner container **32** is attached to the toner replenishing device **60** again, toner remains between the container opening **33***a* and the container-setting-portion inner circumferential surface **615***a*. Moreover, when toner adheres to the container-setting-portion inner circumferential surface **615***a*, the following problems occur. That is, when a new toner container **32** is attached as well as when the same toner container **32** is attached again,

toner remains between the container opening **33***a* and the container-setting-portion inner circumferential surface **615***a*. If toner remains between the container opening **33***a* and the container-setting-portion inner circumferential surface **615***a*, the positioning accuracy decreases when the position of the toner container **32** in relation to the toner replenishing device **60** is determined by the fitting of the container opening **33***a* and the container setting portion **615**.

Moreover, in the case of a configuration in which the outer circumferential surface of the container opening **33***a* slides on the inner circumferential surface of the container setting portion **615**, the slidability may decrease due to toner and a rotational torque of the toner container **32** may increase. Further, when the outer circumferential surface of the container opening **33***a* continuously slides on the inner circumferential surface of the container setting portion **615** in a state where toner remains therebetween, an aggregate of toner may be caused.

In the toner container **32** of the present embodiment, the front end surface of the container body **33** protrudes in the rotation axis direction further than the front end surface to which the nozzle insertion opening **331** of the nozzle receiver **330** is open. That is, in the toner container **32**, the opening position of the nozzle insertion opening **331** is located closer to the container inner side (the rear end side) than the front end of the container opening **33***a* which is the opening position of the container body **33**.

As described above, since the opening position of the nozzle insertion opening **331** is located at an inner position than the opening position of the container body **33**, it is possible to suppress toner from adhering to the outer circumferential surface of the container opening **33***a*. This is because, when toner leakage occurs when the conveying nozzle **611** is removed from the toner container **32**, the toner scattering after having leaked from the nozzle insertion opening **331** can rarely flow around the front end of the front end opening **305**. Moreover, since the toner leaking and falling from the nozzle insertion opening **331** is caught on the inner circumferential surface on the lower side of the front end opening **305**, it is possible to prevent toner from adhering to the container-setting-portion inner circumferential surface **615***a*. As described above, since the toner leaking from the nozzle insertion opening **331** can be stored in a region surrounded by the inner circumferential surface located closer to the container inner side (the rear end side) than the front end surface of the front end opening **305**, it is possible to suppress toner from scattering out of the toner container **32**.

As illustrated in FIGS. **11** and **13**, in the present embodiment, the container setting portion **615** of the toner replenishing device **60** is away from the opening (the nozzle opening **610** or the nozzle insertion opening **331**) where scattering toner is likely to occur before and after the toner container **32** is attached. Moreover, the front end of the front end opening **305** of the toner container **32** is away from the opening (the nozzle opening **610** or the nozzle insertion opening **331**) where scattering toner is likely to occur before and after the toner container **32** is attached. Thus, it is possible to prevent toner from leaking from the nozzle insertion opening **331** before the toner container **32** is attached and from contact portions of the container seal **333** and the conveying nozzle **611** in a state where the toner container **32** is attached to the toner replenishing device **60**. Further, the container setting portion **615** of the toner replenishing device **60** is away from the nozzle opening **610** when the toner container **32** is attached or detached. Moreover, the front end of the front end opening **305** of the toner container **32** is away from the elastic sheet **332**.

As described above, the positioning in a direction orthogonal to the rotation axis, of the toner container **32** in relation to the toner replenishing device **60** is realized by the fitting of the outer circumferential surface of the container opening **33***a* and the container-setting-portion inner circumferential surface **615***a* of the container setting portion **615**. That is, the outer circumferential surface of the container opening **33***a* of the container body **33** is a positioning portion that realizes alignment with respect to the toner replenishing device **60** which is a powder conveying device. Thus, when a toner contamination remains on the outer circumferential surface of the container opening **33***a*, the fitting state of the outer circumferential surface with respect to the inner circumferential surface of the container setting portion **615** may change and the positioning accuracy may decrease. In contrast, since the toner container **32** of the present embodiment can suppress toner from reaching the outer circumferential surface of the container opening **33***a*, the positioning accuracy of the toner container **32** in relation to the toner replenishing device **60** is stabilized.

Further, the contact portions of the outer circumferential surface of the container opening **33***a* and the inner circumferential surface of the container setting portion **615** are such a relation that the contact portions slide on each other when the toner container **32** rotates. That is, the outer circumferential surface of the container opening **33***a* of the container body **33** which is a powder storage member is a sliding portion that slides on the toner replenishing device **60** which is a powder conveying device. When toner enters into the sliding portion, sliding load may increase and a rotational torque of the toner container **32** may increase. In contrast, the toner container **32** of the present embodiment can suppress toner from reaching the outer circumferential surface of the container opening **33***a* and suppress toner from entering into the contact portion that makes contact with the inner circumferential surface of the container setting portion **615**. Thus, since an increase in the sliding load is suppressed and the slidability is stabilized, it is possible to suppress an increase in the rotational torque of the toner container **32**. Moreover, since it is possible to suppress toner from entering into the sliding portion, it is possible to suppress formation of an aggregate of toner, which may be formed when toner is pressed and hardened by the sliding portion.

As described above, in the toner container **32** of the present embodiment, the outer circumferential surface of the container opening **33***a* of the container body **33** serving as a powder storage member is a positioning portion and a sliding portion in relation to the toner replenishing device **60**. Moreover, since it is possible to suppress toner from adhering to the outer circumferential surface of the container opening **33***a*, the toner container **32** of the present embodiment provides stable positioning accuracy in relation to the toner replenishing device **60** and provides stable slidability during rotation.

Moreover, as described above, when the toner container **32** is attached to the toner replenishing device **60**, the container seal **333** is squeezed by the nozzle shutter flange portion **612***a*. As a result, the nozzle shutter flange portion **612***a* is closely compressed by the container seal **333**, and toner leakage can be prevented more reliably. Since the elastic sheet **332** is disposed closer to the inner side (the rear end side) in the longitudinal direction than the opening position, a columnar void portion is provided extending from the front end of the toner container **32** to the front end surfaces of the elastic sheet **332** and the container seal **333**.

The nozzle opening **610** of the conveying nozzle **611** is closed by the nozzle shutter **612** in a state where the toner container **32** is not attached to the toner replenishing device

60. Moreover, in a state where the toner container **32** is attached to the toner replenishing device **60**, it is necessary to open the nozzle shutter **612** to create a state where toner can be received therein.

In the toner replenishing device **60**, a columnar void portion is provided extending from the front end of the front end opening **305** to the front end surfaces of the elastic sheet **332** and the container seal **333**. An entire portion or a portion of a withdrawal space of the nozzle shutter **612** when the nozzle shutter **612** is opened is received in the void portion. Moreover, a columnar void portion is provided extending from the front end of the front end opening **305** to the front end surfaces of the elastic sheet **332** and the container seal **333**. An entire portion or a portion of the nozzle shutter spring **613** for shutting the nozzle shutter **612** is accommodated in the void portion. Due to such a configuration, an arrangement space of the nozzle shutter **612** and the nozzle shutter spring **613** can be decreased.

As illustrated in FIG. **13**, in the present embodiment, in a state where the toner container **32** is attached to the toner replenishing device **60**, a withdrawal position of the nozzle shutter **612** is such that a portion closer to the nozzle front end side than the nozzle shutter flange portion **612***a* is positioned inside the container seal **333**. A portion closer to the nozzle base side than the nozzle shutter flange portion **612***a* is approximately received in the columnar void portion provided so as to extend from the opening position (the front end) of the front end opening **305** to the front end surface of the container seal **333**. Further, the nozzle shutter spring **613** in the compressed state is approximately received in the columnar void portion.

With such a configuration, it is possible to shorten the distance from the opening position of the front end opening **305** which is the frontmost end of the toner container **32** to a toner falling portion (a position at which the falling path defining portion **64** is connected to the conveying nozzle **611**) of the toner replenishing device **60**. In this way, it is possible to decrease the size of the device body.

As described with reference to FIGS. **16** to **22**, the first shutter inner circumference rib **612***b* bumps against an edge, that is, an upper portion of the inner wall surface of the sheet member guide **611***a* of the conveying nozzle **611**, on the nozzle front end side of the nozzle opening **610** in a state where the nozzle shutter **612** is closed. As a result, the first shutter inner circumference rib **612***b* performs a function of preventing removal of the nozzle shutter **612**. Moreover, the first shutter inner circumference rib **612***b* performs a function of stopping rotation of the nozzle shutter **612** in such a manner that the first inner-circumference-rib front end **612***g* which is an end in the circumferential direction thereof bumps against the nozzle-opening transversal edge **611***s* which is a transversal edge of the nozzle opening **610**. The same function of stopping rotation of the nozzle shutter **612** is also achieved in a state where the toner container **32** is attached to the toner replenishing device **60**.

Moreover, as described above, the inner diameter of the second and third shutter inner circumference ribs **612***c* and **612***d* is slightly smaller than the outer diameter of the conveying nozzle **611**. As an example, when the outer diameter of the conveying nozzle **611** is ϕ15 mm, the inner diameter of the second shutter inner circumference ribs **612***c* and **612***d* may be set to between approximately ϕ4.8 mm and 14.9 mm. In this manner, the second and third shutter inner circumference ribs **612***c* and **612***d* having a columnar shape of which the inner diameter is slightly smaller than the outer diameter of the conveying nozzle **611** are provided on the inner circumferential surface of the nozzle shutter **612**. As a result, it is possible to cover the gap between the inner circumferential surface of the nozzle shutter **612** and the outer circumferential surface of the conveying nozzle **611** and to obtain a toner sealing function without a sealing member. Thus, it is possible to obviate the need of a sealing member such as sponge or rubber.

Since it is not necessary to use a sealing member separately from the nozzle shutter **612**, it is possible to reduce the cost while preventing toner leakage.

As a configuration of preventing toner leakage, a donut-shaped sealing member may be disposed instead of the second and third shutter inner circumference ribs **612***c* and **612***d*. However, since the gap between the inner circumferential surface of the nozzle shutter **612** and the outer circumferential surface of the conveying nozzle **611** is very narrow, the donut-shaped sealing member cannot enter into the gap. Thus, when the donut-shaped sealing member is disposed, a donut-shaped nozzle shutter sealing member **612***h* is disposed as illustrated in FIG. **29**. In this case, the outer diameter of a nozzle shutter seal receiving portion **612***j* is set to be smaller than the diameter of the nozzle shutter spring **613** so that the nozzle shutter spring **613** makes contact with the nozzle shutter spring receiving surface **612***f*.

When the nozzle shutter **612** is assembled with the conveying nozzle **611**, the nozzle shutter **612** needs to have a certain degree of elastic deformability in order to temporarily deform the nozzle shutter **612**. This is because, if a material that is too hard to be elastically deformed, the nozzle shutter **612** may be broken without being elastically deformed during assembling. The nozzle shutter **612** is formed of a material having appropriate elasticity, and for example, when the outer shape of the conveying nozzle **611** is a cylindrical shape, the nozzle shutter **612** also has a cylindrical shape having an inner diameter slightly larger than the outer diameter of the conveying nozzle **611**. Moreover, the first shutter inner circumference rib **612***b* that is a projection protruding inward is provided in an inner diameter portion of the nozzle shutter **612**. By forming the first shutter inner circumference rib **612***b* so as to face the nozzle opening **610** of the conveying nozzle **611**, the first shutter inner circumference rib **612***b* can function as a stopper that prevents removal and rotation of the nozzle shutter **612**. A portion of the conveying nozzle **611** engaging with the projection of the nozzle shutter **612** is not limited to the nozzle opening **610**, and an optional portion of the conveying nozzle **611** may engage with the projection as long as the projection provides the removal and rotation stopping function.

According to experiments of the present inventors, it is preferable that a resin material having a tensile modulus of elasticity of between 500 MPa and 2000 MPa is selected as the material of the nozzle shutter **612**.

When the nozzle shutter **612** is assembled with the conveying nozzle **611**, the three ribs **612***b* to **612***d* provided on the inner circumferential surface of the nozzle shutter **612** become a resistance when the conveying nozzle **611** is inserted into the nozzle shutter **612**. This resistance increase particularly when the first shutter inner circumference rib **612***b* climbs over the sheet member guide **611***a* to enter into the nozzle opening **610**.

In this case, if the nozzle shutter **612** is formed of a material having a certain degree of elasticity, the nozzle shutter **612** is deformed and assembling can be performed easily. Further, there is another merit that a sliding load which may increase when the second and third shutter inner circumference ribs **612***c* and **612***d* tightly fasten the conveying nozzle **611** does not increase.

Moreover, if the nozzle shutter **612** is too easily deformed, the removal and rotation stopping function of the first shutter inner circumference rib **612***b* is impaired.

The above merit can be stably obtained by selecting polyethylene or polypropylene as a material having a certain degree of elasticity used for the nozzle shutter **612**. Moreover, it is preferable that the thickness of the nozzle shutter cylinder portion **612***e* of the nozzle shutter **612** is between 0.3 mm and 0.5 mm.

Since the nozzle shutter **612** has such material properties and shape as described above, it is possible to decrease the cost of a shutter mechanism that opens and blocks the nozzle opening **610**.

Next, the toner container **32** during storage will be described.

The toner container **32** illustrated in FIG. **7** has the following configuration. That is, the toner container **32** is a powder container which stores toner as a powder-like developer therein and in which the cap **370** as a sealing member that seals the nozzle insertion opening **331** serving as a developer discharging opening can be attached to the container opening **33***a*. As described above, the container opening **33***a* is a portion of the container body **33**, and as illustrated in FIGS. **6**, **9**, and **11** and other figures, the container body **33** has the container opening **33***a* provided so as to pass through the container front end cover **34** necessary when attaching the toner container **32** to the toner replenishing device **60**. Due to this, the container opening **33***a* of the container body **33** can be exposed from the container front end cover **34**. Moreover, since the container opening **33***a* which is a portion of the container body **33** in which toner is stored can be sealed directly by the cap **370**, it is possible to improve a sealing effect and to prevent toner leakage more reliably.

In the toner container **32** of the present embodiment, cap flange portion **371** is provided in the cap **370**. In a state where the cap **370** is attached to the toner container **32**, as illustrated in FIG. **7**, the cap flange portion **371** covers the IC tag **700** provided on the container front end cover **34**. Due to this, it is possible to prevent external contact or impact on the IC tag **700** during storage of the toner container **32** and to protect the IC tag **700**.

Moreover, in the toner container **32** of the present embodiment, the cap flange portion **371** of the cap **370** is larger than the outer diameter of the container front end cover **34** and the container body **33**. Due to this, it is possible to prevent damage of the toner container **32** during falling and to protect the toner container **32**.

Further, since the container opening **33***a* which is a portion of the container body **33** is sealed directly by the cap **370**, the sealing effect is satisfactory as compared to a configuration in which the container opening **33***a* is sealed by a member (for example, the container front end cover **34**) separate from the container body **33**. Moreover, it is also possible to seal the container body **33** as long as the container opening **33***a* is sealed directly. Moreover, if the container body **33** can be sealed, it is possible to prevent air or moisture from entering into the container body **33** and to reduce the amount of material for packaging the toner container **32** during storage.

When the toner container **32** is used (the toner container **32** is attached to the toner replenishing device **60**), the cap **370** is removed. An optional method such as a screw method or a hook method may be used as a method of attaching the cap **370** to the toner container **32** is not particularly limited as long as the cap **370** can be attached. In this case, an attached portion of the toner container **32** such as a screw thread of the screw method or a hook portion of the hook method is provided on the outer circumferential surface of the container opening **33***a* exposed from the container front end cover **34**. In the toner container **32** of the present embodiment, a screw thread is provided on the outer circumferential surface of the container opening **33***a*, and a screw method is employed as a method of attaching the cap **370** to the toner container **32**.

Moreover, in the case of a configuration in which the toner container **32** is sealed by the cap **370**, the degree of adhesion between the container opening **33***a* of the toner container **32** and the cap **370** may be enhanced using a packing material or the like. By enhancing the degree of adhesion, it is possible to prevent air or moisture from entering into the container body **33**.

Here, the problems of the conventional toner container in which the space (the container body) in which toner is stored cannot be sealed directly by a sealing member will be described.

In recent years, with a decrease in the fixing temperature and the toner particle size, the toner used in an image forming apparatus tends to deteriorate in heat resistance performance. For example, when the toner is exposed to a high temperature environment during transportation, the toner aggregates, and in a worst case, the toner is solidified, and it is impossible to supply the toner from a toner container to the image forming apparatus. It is known that the aggregation and solidification of toner occurs remarkably easily when humidity increases at the same temperature environment. Toner containers are supplied to users in various routes, and it is difficult to manage the environments of the supply routes. For example, although toner containers are transported via land, airline, and sea, it is difficult to manage the temperature and humidity of such environments.

Although a method that uses a container for controlling a transportation environment may be used as a countermeasure against such a problem, it is impossible to deal with all transportation routes and this incurs a lot of cost. With regard to such a problem, since the toner container **32** of the present embodiment can seal the container opening **33***a* which is a portion of the container body **33** directly by the cap **370**, it is possible to improve the sealing effect and to prevent toner leakage more reliably. Further, since the sealing effect is improved, the toner container **32** during storage is rarely affected by the external environment.

Moreover, since the toner container **32** can be attached to the toner replenishing device **60** when the cap **370** is removed, it is possible to provide the toner container **32** that is easy to use.

Further, since the cap **370** has such a shape that protects the IC tag **700** and the toner container **32**, it is possible to reduce a cushioning material and an individual packing box for packing the toner container **32** and to reduce the size of the package. Thus, it is possible to reduce an environmental load by reducing the materials used.

Moreover, after the toner container **32** which is a powder container is supplied to users, the toner container **32** is usually handled by users. Since there is no particular method of regulating the way the toner container is handled, the toner container **32** may sometimes be handled violently. Thus, a sufficient countermeasure against vibration and dropping needs to be taken so that toner leakage does not occur even when the toner container **32** is handled violently.

To prevent toner leakage, it is necessary to prevent leakage from the nozzle insertion opening **331**. Moreover, to prevent this leakage, it is necessary to prevent a gap from being provided in the elastic sheet **332** that covers the nozzle insertion opening **331** formed by the container seal **333** and the container seal attached wall **336**.

Next, characteristic features of the toner container **32** of the present invention illustrated in the first embodiment will be described.

Example 1

A toner container **32** according to Example 1 of the present embodiment has a plurality of elastic sheets **332** which is disposed so as to overlap at least partially. More specifically, at least two of the plurality of elastic sheets are disposed so as to overlap at least partially over the entire area of the nozzle insertion opening **331** in a diametric direction of the nozzle insertion opening **331** which is a nozzle insertion opening of the nozzle receiver **330**. Further, it is preferable that the two elastic sheets are disposed so as to overlap at least partially over the entire area of the front end opening **305** in the diametric direction of the front end opening **305**.

FIG. **21** is a diagram illustrating the elastic sheet **332** included in the toner container **32** of Example 1, and FIG. **22** is an enlarged cross-sectional view of the nozzle receiver **330** and the conveying nozzle **611** in a state where the toner container **32** is attached to the toner replenishing device **60** illustrated in FIG. **13**. Moreover, FIG. **23** is a front view of the elastic sheet **332** in the state of FIG. **22** when seen from the front end side.

As illustrated in FIG. **1**, the toner container **32** includes the container body **33**, the nozzle receiver **330**, the container seal **333**, and the elastic sheet **332**.

The container body **33** is a powder storage member that stores toner therein, and the nozzle receiver **330** includes the nozzle insertion opening **331** provided in an opening on the other end side of the container body **33**. Moreover, the container seal **333** formed from an elastic body is a member that defines the vicinity of the other end of the nozzle insertion opening **331** and is a member that seals the space between the nozzle receiver **330** and the conveying nozzle **611**.

Moreover, the elastic sheet **332** is a member that opens and blocks the nozzle insertion opening **331** and is formed of a thin film sheet made from an elastic member having flexibility. Examples of an elastic material used for the elastic sheet **332** include silicone rubber, urethane rubber; fluorine rubber, ethylene propylene diene monomer (EPDM) rubber, and natural rubber, and other elastic materials having flexibility can be also used. Moreover, in order to improve slidability of the elastic sheet **332** sliding on the sheet member guide **611***a*, the surface of the elastic sheet **332** may be coated with talc or the like, or components for securing slidability may be added in advance to the elastic material.

As illustrated in FIGS. **1** and **21**, the elastic sheet **332** includes two elastic sheet members of the first and second elastic sheets **332***a* and **332***b* so that the sheet members are disposed so as to overlap at the sheet overlapping portion **332***c*. Moreover, the sheet overlapping portion **332***c* blocks a portion of the elastic sheet **332** which is opened when the conveying nozzle **611** is inserted. Moreover, as illustrated in FIG. **21**, the first and second elastic sheets **332***a* and **332***b* have planar surfaces having such a shape that is larger by an overlapping margin than a semi-circle, which overlap each other at the central portion of the nozzle insertion opening **331**.

The first and second elastic sheets **332***a* and **332***b* are assembled so that small tension is applied in a state where the sheets are expanded to a length slightly larger than their natural length.

Although the toner container **32** of Example 1 uses two elastic sheets **332**, three or more elastic sheets may be used in order to prevent toner leakage more reliably.

Moreover, in the toner container **32**, two elastic sheets **332** are "surface" overlapped at the sheet overlapping portion **332***c* to block a portion of the elastic sheet **332** in which the conveying nozzle **611** is expanded to be open, and an air-tight state is created by the sheet overlapping portion **332***c*.

In the toner container (powder container) of JP 07-261492 A, a slit is provided in a radial form (like the asterisk symbol) in one elastic sheet member. Here, a portion of the elastic sheet member expanded by the powder conveying nozzle will be referred to as a "slit portion".

In such a configuration, in relation to the insertion direction of the powder conveying nozzle, the slit portion does not overlap with other neighboring slit portions, and only end surfaces in the direction orthogonal to the insertion direction of the powder conveying nozzle make contact with each other. Such a structure that no slit portion overlaps in the insertion direction of the powder conveying nozzle will be referred to as a "line" blocking structure for the convenience's sake.

In this "line" blocking structure, when elastic deformation occurs in the elastic sheet member due to vibration or impact, such a gap that powder can pass through is easily provided in the slit portion. When such a gap that powder can pass through is provided, a state where powder can leak is created. Moreover, in the conventional elastic sheet member in which the slit portion having such a "line" blocking structure is provided, if small tension is applied, the slit portion will be open and tension cannot be applied. Thus, when the toner container **32** is detached from the toner replenishing device **60**, the force that blocks the slit portion is small and powder may leak.

On the other hand, in the toner container **32** according to Example 1 of the present embodiment, the plurality of elastic sheets **332** is disposed so as to overlap at the sheet overlapping portion **332***c* in which the elastic sheets overlap at least partially in the insertion direction of the powder conveying nozzle. Moreover, the sheet overlapping portion **332***c* which is a portion where the plurality of elastic sheets **332** overlap blocks the portion of the elastic sheet **332** expanded by the conveying nozzle **611** with a "surface" having a certain area. Such a structure that the sheet overlapping portion **332***c* is provided in the insertion direction of the conveying nozzle **611** will be referred to as a "surface" blocking structure for the convenience's sake.

Due to this, even when elastic deformation occurs in the elastic sheet **332** due to vibration or impact, the "surface" blocking structure makes such a gap that powder can pass through a portion of the elastic sheet member, through which the powder, conveying nozzle passes, difficult to be provided as compared to the "line" blocking structure.

Moreover, Example 1 has a structure in which the sheet overlapping portion **332***c* in which the plurality of elastic sheets **332** overlap at least partially in relation to the insertion direction of the conveying nozzle **611** is provided. Moreover, the "surface" blocking structure includes such a structure that a plurality of elastic sheets overlap at least partially in the direction orthogonal to the insertion direction of the powder conveying nozzle. More specifically, an example of such a structure is that the elastic sheets are disposed so as to be bent toward the downstream side in the insertion direction of the conveying nozzle **611** and the bent portions make contact with each other to form an overlapping portion so that overlapping portion is provided in the insertion direction of the conveying nozzle **611**.

Such a structure in which the bent portions make contact with each other to form the overlapping portion makes such a gap that powder can pass through difficult to be provided as compared to the "line" blocking structure. However, such a gap that powder can pass through can be provided easily as

compared to a structure having the sheet overlapping portion **332***c* in which the plurality of elastic sheets **332** overlap at least partially in the insertion direction of the conveying nozzle **611**. Here, a free end **432** of the elastic sheet **332** in FIG. **21** is a portion that is not interposed by the attaching portion **337** and the sheet stopper **335** among the portions that form the end surfaces of the elastic sheet **332**.

In the toner container **32** having a plurality of elastic sheets **332**, when the conveying nozzle **611** is removed after being inserted therein, the plurality of elastic sheets **332** restores to their original positions by their elastic force so as to restore the sheet overlapping portion **332***c*. In a configuration with no sheet overlapping portion **332***c*, when the powder conveying nozzle is removed after the free end **432** of the elastic sheet **332** is displaced due to the powder conveying nozzle inserted into the elastic sheet **332**, such restoring force that the free end **432** restores following the held end acts on the free end **432**. Here, when the elastic sheets are assembled in advance so that tension is applied, the action of the free end restoring following the held end is facilitated.

In the elastic sheet **332** according to Example 1 of the present embodiment, the first and second elastic sheets **332***a* and **332***b* are assembled so that small tension is applied in a state where the sheets are expanded to a length slightly larger than their natural length. Due to this, even if the conveying nozzle **611** is removed when the toner container **32** is detached from the toner replenishing device **60**, the first and second elastic sheets **332***a* and **332***b* can be sealed again by their restoring force so as to overlap partially. Thus, it is possible to suppress leakage of powder (toner) better than the powder container having the conventional elastic sheet member in which a slit is provided in one elastic sheet member.

On the other hand, the following problems occur in the structure in which the elastic sheets are disposed so as to be bent toward the downstream side in the insertion direction of the conveying nozzle **611**. That is, in order to increase restoring force that restores the overlapping portion again, it is necessary to assemble the elastic sheets so that tension is applied in advance in two directions of the insertion direction of the conveying nozzle **611** and the direction orthogonal to the insertion direction of the conveying nozzle **611**. However, when tension is applied in the direction orthogonal to the insertion direction of the conveying nozzle **611**, the portions that are bent toward the downstream side in the insertion direction of the conveying nozzle **611** are opened similarly to the "line" blocking structure. Thus, the area of the overlapping portion decreases if the restoring force is increased.

That is, in the structure in which the elastic sheets are disposed so as to be bent toward the downstream side in the insertion direction of the conveying nozzle **611**, there is a tradeoff relation between increasing the restoring force and maintaining the area of the overlapping portion. Thus, when the elastic sheets are assembled so that tension is applied in advance thereto, a gap that powder can pass through is likely to be provided.

In contrast, the structure that includes the sheet overlapping portion **332***c* in which the plurality of elastic sheets **332** overlap at least partially in the insertion direction of the conveying nozzle **611** has the following advantages. That is, when elastic sheets are assembled so that tension is applied in advance thereto, both increasing the restoring force and maintaining the area of the overlapping portion can be realized.

When the toner container **32** is attached to the toner replenishing device **60**, the conveying nozzle **611** is inserted in such a manner to expand the sheet overlapping portion **332***c* of the elastic sheet **332** as illustrated in FIGS. **22** and **23**. Since the elastic sheet **332** is an elastic material having flexibility, when the conveying nozzle **611** is inserted, the elastic sheet **332** is elastically deformed so that the sheet overlapping portion **332***c* is expanded.

On the other hand, when the toner container **32** is detached from the toner replenishing device **60**, the conveying nozzle **611** is removed in such a manner that the elastic sheet **332** scrapes off the contamination on the outer circumferential surface of the conveying nozzle **611**. This is because the elastic sheet **332** elastically deformed with insertion of the conveying nozzle **611** makes contact with the surface of the conveying nozzle **611** due to contacting pressure of the restoring force.

Since the elastic sheet **332** has flexibility, after the conveying nozzle **611** is removed, the two elastic sheets **332** form the sheet overlapping portion **332***c* again at the central portion. When the sheet overlapping portion **332***c* is restored at the central portion, an air-tight state is created again.

As illustrated in FIGS. **11** to **13** and **22** and other figures, the sheet member guide **611***a* having a hemispherical shape of which the diameter is approximately the same as the diameter of the conveying nozzle **611** is provided in an end on the side (the side opposite to the base side) in the axial direction of the conveying nozzle **611** facing the toner container. By using such a round sheet member guide **611***a*, when the conveying nozzle **611** expands the overlapping portion at the center of the elastic sheet **332**, since force can be applied gradually, it is possible to expand the elastic sheet **332** smoothly.

Moreover, an ideal shape of the sheet member guide **611***a* may be selected by taking the slidability in relation to the elastic sheet **332** and elasticity of the elastic sheet **332** into consideration.

The surface of the sheet member guide **611***a* may be coated so that toner can rarely adhere to the surface. Since the sheet member guide **611***a* is a portion that makes direct contact with the toner inside the toner container **32**, during replacement of the toner container **32**, the sheet member guide **611***a* may be exposed with the toner adhering thereto, and the toner may fall into the toner container receiving portion **70** or the like to contaminate the copying machine **500**. However, since the surface of the sheet member guide **611***a* is processed in advance so that toner can rarely adhere, it is possible to prevent this.

In the toner container **32**, the nozzle insertion opening **331** is sealed by the "surface" overlapping of the sheet overlapping portion **332***c*. Thus, when vibration or impact is applied to the toner container **32** so that the elastic sheet **332** is elastically deformed, a gap that toner can pass through is rarely provided. In this manner, since it is possible to suppress formation of the gap that the toner can pass through, it is possible to suppress leakage of toner from the toner container **32** in a state where the toner container **32** is not attached to the toner replenishing device **60**. Thus, even when the toner container **32** is handled violently during transportation or the like, it is possible to suppress the occurrence of toner leakage from the toner container **32**. Therefore, it is possible to suppress the occurrence of toner leakage resulting from vibration or dropping during transportation of the toner container **32**.

Moreover, since the nozzle insertion opening **331** which is a nozzle insertion opening is opened and blocked by elastic deformation of the elastic sheet **332**, it is possible to simplify the configuration of opening and blocking the nozzle insertion opening as compared to the toner container of JP 2009-276659 A and to reduce the cost of the toner container **32**.

Moreover, as described above, tension is applied to the elastic sheet **332**, and the adhesion (air-tightness) of the two elastic sheets **332** in the overlapping portion is improved.

Thus, it is possible to prevent toner leakage more effectively, and satisfactory characteristics against vibration and impact are obtained.

The toner container **32** according to Example 1 of the present embodiment can suppress leakage of toner resulting from vibration or dropping during transportation of the toner container **32**. In the toner replenishing device **60** including such toner container **32**, it is possible to suppress leakage of toner when the toner container **32** is replaced. Thus, it is possible to suppress the occurrence of contamination inside the device and contamination outside the device resulting from the leakage of toner.

Moreover, in the copying machine **500** including such a toner replenishing device **60**, it is possible to suppress the occurrence of contamination inside the device and contamination outside the device when the toner container **32** is replaced.

As illustrated in FIG. **21**, the first elastic sheet **332***a* blocks a portion of the nozzle insertion opening **331** and the other portion (the portion depicted by a broken line in FIG. **21**) is an opening. Similarly, the second elastic sheet **332***b* blocks a portion of the nozzle insertion opening **331** and the other portion (the portion depicted by a broken line in FIG. **21**) is an opening. Moreover, the opening of the first elastic sheet **332***a* is disposed so as be covered by the second elastic sheet **332***b*, and the opening of the second elastic sheet **332***b* is disposed so as to be covered by the first elastic sheet **332***a*. That is, the first and second elastic sheets **332***a* and **332***b* are disposed so that the positions of the openings are shifted from each other.

In such an arrangement, when the conveying nozzle **611** enters, as illustrated in FIGS. **22** and **23**, the two elastic sheets **332** are elastically deformed so that the conveying nozzle **611** enters so as to pass through the respective openings. In this case, the elastically deformed elastic sheets **332** make close contact with the outer circumferential surface of the conveying nozzle **611**, the sealing property in the state where the conveying nozzle **611** is inserted is satisfactory.

Moreover, in a state where the conveying nozzle **611** is not inserted, the plurality of elastic sheets **332** is disposed so as to overlap so that the insertion openings are shifted from each other, and the other elastic sheet **332** overlaps with a portion that serves as a boundary line between the elastic sheet and the opening to configurate the sheet overlapping portion **332***c*. In this manner, since the portion that serves as the boundary line between the elastic sheet and the opening forms the sheet overlapping portion **332***c* and the elastic sheets **332** are in close contact, it is possible to prevent the occurrence of toner leakage due to vibration during transportation.

Moreover, the toner container **32** according to Example 1 of the present embodiment rotates to supply toner to the nozzle opening **610** of the conveying nozzle **611**, and during this rotation, the outer circumferential surface of the conveying nozzle **611** slide on the elastic sheet **332**.

Thus, in a portion of the elastic sheet **332** making contact with the outer circumferential surface of the conveying nozzle **611**, force (friction force) that causes the portion to remain at the contact position may occur and force that causes the portion to be pulled in the circumferential direction may be applied.

In such a case, the force that causes the portion to be pulled in the circumferential direction can be distributed to the two elastic sheets **332** as compared to the conventional elastic sheet member having the slit portion. Since the amount of deformation of the respective elastic sheets **332** is small, it is possible to prevent the occurrence of toner leakage even during rotation of the toner container **32**.

In a toner container of such a type that the toner container itself does not rotate and includes a rotating conveying member, the elastic sheet **332** of Example 1 can be similarly used.

In the configuration illustrated in FIG. **21**, the first and second elastic sheets **332***a* and **332***b* are arranged so that the free ends **432** (**432***a* and **432***b*) are disposed in a reverse positional relation in the diametric direction of the front end opening **305**. In other words, one free end **432** overlaps from the outer side with the surface portion of the other elastic sheet and the other free end **432** overlaps from the inner side with the surface portion of one elastic sheet. Moreover, in the insertion direction of the conveying nozzle **611**, both elastic sheets **332** overlap over the entire area in the diametric direction of the front end opening **305**, and this overlapping portion is the sheet overlapping portion **332***c*. In this manner, when the conveying nozzle **611** is inserted, portions of the respective elastic sheets **332** closer to the free ends **432** are displaced in a direction away from the center of the front end opening **305**. Moreover, when the conveying nozzle **611** is removed, the free ends **432** of the respective elastic sheets **332** are displaced in a direction toward the center of the front end opening **305**. After the conveying nozzle **611** is completely removed, the free ends **342** form the overlapping portion **332***c* in the insertion direction of the conveying nozzle **611**.

Example 2

Next, an elastic sheet **332** according to Example 2, disposed in the toner container **32** of the first embodiment will be described.

FIG. **24** is a diagram illustrating an elastic sheet **332** of Example 2. In Example 2, first and second elastic sheets **332***a* and **332***b* that configurate the elastic sheet **332** have a shape that covers the entire nozzle insertion opening **331**, and first and second round through-holes **332***d* and **332***e* are provided in a portion thereof. That is, Example 2 has a configuration in which two elastic sheets **332** having a round hole-shaped opening overlap with each other.

In Example 2, the first and second elastic sheets **332***a* and **332***b* in which the first and second round through-holes **332***d* and **332***e* which are openings for inserting the conveying nozzle **611** are provided at positions deviated from the center of the nozzle insertion opening **331** disposed approximately at the center of the front end opening **305** are arranged so as to overlap with each other. In the overlapping state, the first and second elastic sheets **332***a* and **332***b* are disposed so that the first and second round through-holes **332***d* and **332***e* are shifted from the center of the nozzle insertion opening **331**. Since the round holes are shifted from each other, the other elastic sheet **332** can seal the round hole provided in one elastic sheet **332**. Moreover, the two elastic sheets **332** overlap and make close contact with the surrounding of the round hole. Due to such a configuration, similarly to the configuration illustrated in FIG. **21**, both elastic sheets **332** overlap over the entire area in the diametric direction of the front end opening **305** in the insertion direction of the conveying nozzle **611**, and the overlapping portion functions as the sheet overlapping portion **332***c*. Thus, it is possible to suppress toner leakage in a state where the conveying nozzle **611** is not inserted.

In the elastic sheet **332** of Example 2, when the conveying nozzle **611** is inserted, the first and second round through-holes **332***d* and **332***e* are displaced in the direction toward the nozzle insertion opening **331**. Moreover, the diameter of the first and second round through-holes **332***d* and **332***e* in the state where the conveying nozzle **611** is not inserted is set to be smaller than the diameter of the conveying nozzle **611**.

Thus, the first and second round through-holes **332***d* and **332***e* are elastically deformed so as to be expanded with insertion of the conveying nozzle **611**.

Here, since the diameter of the first and second round through-holes **332***d* and **332***e* is set to be smaller than the diameter of the conveying nozzle **611**, the restoring force of the two elastic sheet **332** in the state where the conveying nozzle **611** is inserted acts in such a way of tightly fasten the surrounding of the conveying nozzle **611**. Thus, when the toner container **32** is detached from the toner replenishing device **60** (when the conveying nozzle **611** is removed), the conveying nozzle **611** is removed such that the contamination on the outer circumferential surface of the conveying nozzle **611** is scraped off by the elastic sheet **332**, and the scraping-off effect is improved further.

In Example 2, although the opening provided in the elastic sheet **332** is a round hole, the shape of the opening is not limited to the round hole shape. Other opening shapes such as a rectangular shape, a triangular shape, or an elliptical shape may be used as long as the elastic sheets **332** are elastically deformed so that the conveying nozzle **611** can pass therethrough.

In Example 2 illustrated in FIG. **24**, the edges of the first and second round through-holes **332***d* and **332***e* function as the free ends **432** (**432***a* and **432***b*) of the first and second elastic sheets **332***a* and **332***b*. In other words, one free end **432** overlaps from the outer side with the surface portion of the other elastic sheet and the other free end **432** overlaps from the inner side with the surface portion of one elastic sheet. Moreover, in the insertion direction of the conveying nozzle **611**, both elastic sheets **332** overlap over the entire area in the diametric direction of the front end opening **305**, and this overlapping portion is the sheet overlapping portion **332***c*.

Example 3

Next, an elastic sheet **332** according to Example 3, disposed in the toner container **32** of the first embodiment will be described.

FIG. **25** is a diagram illustrating the elastic sheet **332** of Example 3, and FIG. **26** is a front view of the elastic sheet **332** of Example 3 in a state where the toner container **32** is attached to the toner replenishing device **60** when seen from the front end side.

In Example 3, first and second elastic sheets **332***a* and **332***b* that form the elastic sheet **332** have a shape that covers the entire nozzle insertion opening **331**, and first and second slits **332***f* and **332***g* are provided in a portion thereof. That is, Example 3 has a configuration in which two elastic sheets **332** having a slit-shaped opening overlap with each other.

In Example 3, the first and second elastic sheets **332***a* and **332***b* in which the first and second slits **332***f* and **332***g* which are openings for inserting the conveying nozzle **611** are provided at positions deviated from the center of the nozzle insertion opening **331** disposed approximately at the center of the front end opening **305** are arranged so as to overlap with each other. In the overlapping state, the first and second elastic sheets **332***a* and **332***b* are disposed so that the first and second slits **332***f* and **332***g* are shifted from the center of the nozzle insertion opening **331**. Since the slits are shifted from each other, the other elastic sheet **332** can seal the slit provided in one elastic sheet **332**. Moreover, the two elastic sheets **332** overlap and make close contact with the surrounding of the slit. Due to such a configuration, similarly to the configuration illustrated in FIGS. **21** and **24**, both elastic sheets **332** overlap over the entire area in the diametric direction of the front end opening **305** in the insertion direction of the conveying nozzle **611**, and the overlapping portion functions as the sheet overlapping portion **332***c*. Thus, it is possible to suppress toner leakage in a state where the conveying nozzle **611** is not inserted.

In the elastic sheet **332** of Example 3, when the conveying nozzle **611** is inserted, as illustrated in FIG. **26**, the first and second slits **332***f* and **332***g* are displaced in the direction toward the nozzle insertion opening **331**.

As illustrated in FIG. **25**, a small-diameter round hole is provided at both ends of the first and second slits **332***f* and **332***g*. As in the configuration disclosed in JP-A No. 07-261492, if only a slit is provided in an elastic sheet member, when the conveying nozzle **611** is inserted to expand the slit, the ends of the slit may be torn and the elastic sheet member may be torn. On the other hand, as in Example 3, when a small-diameter round hole is provided at both ends of the slit, it is possible to suppress the ends of the slit from being torn when the conveying nozzle **611** is inserted and to suppress the elastic sheet **332** which is an elastic sheet member to be torn.

Moreover, when a slit is provided in an elastic sheet member and a small-diameter round hole is provided at both ends of the slit, if the elastic sheet member is only one sheet as in JP 07-261492 A, toner may leak from the small-diameter round holes. On the other hand, in Example 3, two elastic sheets **332** are arranged so as to overlap, and a portion where one slit is provided is sealed by the other elastic sheet **332**. Thus, even when a small-diameter round hole is provided at both ends of the slit, it is possible to suppress the occurrence of toner leakage.

Moreover, since the configuration of Example 3 where slits are provided can decrease the opening area as compared to the configuration of Example 2 where round holes are provided, it is possible to suppress the occurrence of toner leakage better than Example 2.

In the case of a configuration where a plurality of elastic sheets **332** having a slit provided therein is arranged so as to overlap, the slits may cross and overlap with each other. In a state where slits are blocked, toner cannot pass through the slit portion. Moreover, in the case of a configuration where slits cross each other, even when elastic deformation occurs to cause a gap in the slit portion of one elastic sheet **332** such that toner can pass through the gap, if the slit of the other elastic sheet **332** is blocked, it is possible to prevent passing of toner.

Moreover, since the plurality of elastic sheets **332** overlap with each other, the vibration and impact energy can be distributed to the plurality of elastic sheets **332**. In this case, elastic deformation that causes such a gap in the slit portion of one elastic sheet **332** so that toner can pass through the gap may rarely occur.

From these reasons, it is possible to suppress toner from leaking from the toner container **32** as compared to the configuration disclosed in JP 07-261492 A in which only one elastic sheet member having a slit provided therein is provided.

In Example 3 illustrated in FIG. **25**, the first and second slits **332***f* and **332***g* function as the free ends **432** (**432***a* and **432***b*) of the first and second elastic sheets **332***a* and **332***b*. In other words, one free end **432** overlaps from the outer side with the surface portion of the other elastic sheet and the other free end **432** overlaps from the inner side with the surface portion of one elastic sheet. Moreover, in the insertion direction of the conveying nozzle **611**, both elastic sheets **332** overlap over the entire area in the diametric direction of the

front end opening **305**, and this overlapping portion is the sheet overlapping portion **332***c*.

Example 4

Next, an elastic sheet **332** according to Example 4, disposed in the toner container **32** of the first embodiment will be described.

FIG. **27** is a diagram illustrating the elastic sheet **332** of Example 4. In Example 4, a semi-circular notch **332***h* is provided in an edge portion of an opening near the center of the elastic sheet **332** of Example 1 described with reference to FIGS. **1** and **21** and other figures. The other configuration except that a notch is provided is the same as Example 1, and the same configuration will not be described.

In the elastic sheet **332** of Example 4, since a notch is provided, when the conveying nozzle **611** is inserted, the notch makes contact with the hemi-spherical sheet member guide **611***a*, and the two elastic sheets **332** can be smoothly elastically deformed. As a result, the conveying nozzle **611** can be smoothly inserted in the toner container **32**.

In Example 4 illustrated in FIG. **27**, the first and second elastic sheets **332***a* and **332***b* are arranged so that the free ends **432** (**432***a* and **432***b*) which are edges where the semi-circular notches **332***h* are provided are disposed in a reverse positional relation. Further, one free end **432** overlaps with the surface portion of the other elastic sheet, and similarly, the other free end **432** overlaps with the surface portion of one elastic sheet. Moreover, in the portion between one free end **432** and the other free end **432**, both elastic sheets **332** overlap in the insertion direction of the conveying nozzle **611** and this overlapping portion is the sheet overlapping portion **332***c*. Due to this, the free end **432** that is displaced with insertion of the conveying nozzle **611** overlaps with the other elastic sheet **332** in the insertion direction of the conveying nozzle **611** before the conveying nozzle **611** is inserted.

Second Embodiment

Hereinafter, a second embodiment of the present invention will be described with reference to the drawings. In the second embodiment, the same members or members having the same functions as those of the first embodiment will be denoted by the same reference numerals, and the description thereof may sometimes be omitted. As for the configuration which is not described, the configuration described in the first embodiment can be suitably used.

Hereinafter, the elastic sheet **332** disposed in the toner container **32** of the second embodiment will be described.

FIG. **34** illustrates the toner container **32** of the second embodiment, in which (a) is an exploded perspective view of the toner container **32** of the second embodiment (illustrating the state where the container front end cover **34** is attached), and (b) is a front view of the nozzle receiver **330** included in the toner container **32** of the second embodiment when seen from the other end side. As illustrated in FIG. **34**, in the second embodiment, the elastic sheet **332** includes first, second, and third elastic sheets **332***a*, **332***b*, and **332***j* so that the sheets are disposed on the inner side in the longitudinal direction from the nozzle insertion opening **331** so as to overlap with each other.

The toner container **32** of the second embodiment stores toner therein similarly to the toner container **32** of the first embodiment. Three elastic sheets **332** (**332***a*, **332***b*, and **332***j*) formed of a thin-film elastic material and the container seal **333** are provided in the nozzle insertion opening **331**, and a cap **370** which is a sealing member is provided in the container opening **33***a* which is on a developer discharge side.

FIG. **34** illustrates an example of three elastic sheets **332** according to the second embodiment. The first, second, and third elastic sheets **332***a*, **332***b*, and **332***j* are assembled so that small tension is applied in a state where the sheets are expanded to a length slightly larger than their natural length.

Since three elastic sheets **332** are superimposed, it is possible to improve the sealing property further than the two-sheet configuration and to prevent the occurrence of toner leakage more reliably.

In the example illustrated in FIG. **34**, the sheet overlapping portion **332***c* is provided at the center of the nozzle insertion opening **331** and an air-tight state is created by the sheet overlapping portion **332***c*. When the toner container **32** is attached to the toner replenishing device **60**, the hemi-spherical sheet member guide **611***a* at the front end of the conveying nozzle **611** is inserted so as to expand the central sheet overlapping portion **332***c*. In this case, since the elastic sheet **332** is an elastic body, the elastic sheet **332** is elastically deformed so as to avoid the conveying nozzle **611** and the conveying nozzle **611** is inserted without any problem.

When the toner container **32** is detached from the toner replenishing device **60** (when the conveying nozzle **611** is removed), the conveying nozzle **611** is removed in such a manner that the elastic sheet **332** scrapes off the contamination on the outer circumferential surface of the conveying nozzle **611**. When the toner container **32** is detached from the toner replenishing device **60**, the sheet overlapping portion **332***c* is provided again by the restoring force of the three elastic sheets **332**. Since the elastic sheet **332** is an elastic body, when the sheet overlapping portion **332***c* is provided, the air-tight state is created again.

In the second embodiment, the sheet overlapping portion **332***c* with which the front end of the conveying nozzle **611** makes contact when the conveying nozzle **611** is inserted in the nozzle insertion opening **331** is provided in various shapes so that operability, durability, toner sealing property, and the like are satisfied, details of which will be described later.

When the conveying nozzle **611** enters into the toner container **32** of the second embodiment, portions of the respective elastic sheets **332** closer to the free end **432** are displaced in a direction away from the center of the front end opening **305**, and the conveying nozzle **611** is inserted into the toner container **32**. Since the free ends **432** of the elastic sheets **332** make close contact with the outer shape of the conveying nozzle **611**, the sealing property is improved. Further, since three elastic sheets **332** are superimposed to provide the strength (closing force) of the sheet overlapping portion **332***c*, it is possible to prevent the occurrence of toner leakage due to vibration during transportation more effectively.

Hereinafter, specific examples of the arrangement of three elastic sheets **332** of the second embodiment will be described with reference to FIGS. **35** to **39**. In the configuration illustrated in FIGS. **35** to **39**, the first, second, and third elastic sheets **332***a*, **332***b*, and **332***j* are arranged in that order from the elastic sheet **332** located on the outermost side when three elastic sheets **332** are arranged in the toner container **32**. Moreover, in the configuration illustrated in FIGS. **35** to **39**, an "arrangement angle" and an "overlapping amount" of the elastic sheets **332** are set based on the linear free end **432** of the innermost elastic sheet **332***j* when three elastic sheets **332** are superimposed. As another method, the reference position of the X and Y axes orthogonal to the insertion direction of the conveying nozzle **611** may be provided in the attaching por-

tion **337** that holds the elastic sheet **332**, and the "arrangement angle" and the "overlapping amount" may be set based on this reference position.

Example 1

FIG. **35** is a diagram illustrating arrangement of three elastic sheets **332** of Example 1 of the second embodiment.

In Example 1 illustrated in FIG. **35**, three elastic sheets **332** illustrated in FIG. **21** are superimposed so that the three elastic sheets **332** are at an angle of approximately 120°. Specifically, the second elastic sheet **332***b* is arranged so that the linear free end **432***b* of the second elastic sheet **332***b* is disposed at a position rotated by 120° in the counter-clockwise direction in FIG. **35** about the linear free end **432***j* of the third elastic sheet **332***j*. Moreover, the first elastic sheet **332***a* is arranged so that the linear free end **432***a* of the first elastic sheet **332***a* is disposed at a position rotated by 120° in the clockwise direction in FIG. **35** about the linear free end **432***j* of the third elastic sheet **332***j*.

As illustrated in FIG. **35**, although each of the three elastic sheets **332** is arranged so as to partially have an opening in relation to the front end opening **305**, since the three elastic sheets **332** are arranged so that the positions of the openings are different, the elastic sheets cover the entire nozzle insertion opening **331**.

As illustrated in FIG. **35**, by superimposing the elastic sheets **332** having the same shape at an arrangement angle of approximately 120°, it is possible to arrange three elastic sheets **332** in a well-balanced manner. Moreover, when the toner container **32** is detached from the toner replenishing device **60**, it is possible to further improve the scraping-off effect when the conveying nozzle **611** is removed in such a manner that the elastic sheet **332** scrapes off the contamination on the outer circumferential surface of the conveying nozzle **611** and to further suppress toner scattering. Moreover, since three elastic sheets **332** having the same shape are used, it is possible to decrease the cost.

In Example 1 illustrated in FIG. **35**, the free end **432***j* of the elastic sheet **332***j* is partially covered by the elastic sheet **332***b* and is also partially covered by the elastic sheet **332***a*. In this manner, in the insertion direction of the conveying nozzle **611**, the elastic sheets **332** overlap over the entire area in the diametric direction of the front end opening **305**, and this overlapping portion is the sheet overlapping portion **332***c*.

Example 2

FIG. **36** is a diagram illustrating the arrangement of three elastic sheets **332** of Example 2 of the second embodiment.

In Example 2 illustrated in FIG. **36**, similarly to Example 1 illustrated in FIG. **35**, although each of the three elastic sheets **332** is arranged so as to partially have an opening in relation to the front end opening **305**, since the three elastic sheets **332** are arranged so that the positions of the openings are different, the elastic sheets cover the entire nozzle insertion opening **331**.

As a specific superimposing method, the second elastic sheet **332***b* is arranged so that the linear free end **432***b* of the second elastic sheet **332***b* is disposed at a position rotated by 180° in the counter-clockwise direction in FIG. **36** about the linear free end **432***j* of the third elastic sheet **332***j*. Moreover, the first elastic sheet **332***a* is arranged so that the linear free end **432***a* of the first elastic sheet **332***a* is disposed at a position rotated by 90° in the clockwise direction in FIG. **36** about the linear free end **432***j* of the third elastic sheet **332***j*.

In this manner, the first, second, and third elastic sheets **332***a*, **332***b*, and **332***j* are arranged at positions rotated by 90°.

In Example 2 illustrated in FIG. **36**, one elastic sheet **332** (the first elastic sheet **332***a*) is rotated by 90° to provide strength (closing force) of the sheet overlapping portion **332***c*. More specifically, similarly to the configuration illustrated in FIG. **21**, the second and third elastic sheets **332***b* and **332***j* overlap in the diametric direction of the front end opening **305** to form the overlapping portion **332***c*. For example, it is assumed that an impact is applied to the toner container **32** and the pressure of toner stored therein is applied to the overlapping portion **332***c*. In this case, the free ends **432***b* and **432***j* of the second and third elastic sheets **332***b* and **332***j* try to move in a direction (the left-right direction in FIG. **36**) orthogonal to the direction (the up-down direction in FIG. **36**) along which the overlapping portion **332***c* is provided. However, since the restoring force of the elastic sheet **332***a* having the free end **432***a* disposed in parallel to the orthogonal direction (the left-right direction in FIG. **36**) acts to reinforce the overlapping portion **332***c*, it is possible to improve the strength (closing force) of the sheet overlapping portion **332***c* and to further prevent the toner leakage from the container opening **33***a* due to vibration during transportation.

Example 3

FIG. **37** is a diagram illustrating arrangement of three elastic sheets **332** of Example 3 of the second embodiment.

In Example 3 illustrated in FIG. **37**, similarly to Examples 1 and 2 illustrated in FIGS. **35** and **36**, although each of the three elastic sheets **332** is arranged so as to partially have an opening in relation to the front end opening **305**, since the three elastic sheets **332** are arranged so that the positions of the openings are different, the elastic sheets cover the entire nozzle insertion opening **331**.

In Example 3 illustrated in FIG. **37**, the first and second elastic sheets **332***a* and **332***b* cover the entire nozzle insertion opening **331**. Further, the first and third elastic sheets **332***a* and **332***j* cover the same position and overlap with the second elastic sheet **332***b* at the same position. Specifically, the second elastic sheet **332***b* is arranged so that the linear free end **432***b* of the second elastic sheet **332***b* is disposed at a position rotated by 180° in the counter-clockwise direction in FIG. **37** about the linear free end **432***j* of the third elastic sheet **332***j*. Moreover, the first elastic sheet **332***a* is arranged so that the linear free end **432***j* of the third elastic sheet **332***j* overlaps with the linear free end **432***a* of the first elastic sheet **332***a*.

In Example 3 illustrated in FIG. **37**, three elastic sheets **332** are sequentially superimposed to provide the strength (closing force) of the sheet overlapping portion **332***c*. With this configuration, it is possible to further improve the strength (closing force) of the sheet overlapping portion **332***c* as compared to the configuration illustrated in FIG. **21** and to further prevent the toner leakage from the container opening **33***a* due to vibration during transportation.

Example 4

FIG. **38** is a diagram illustrating arrangement of three elastic sheets **332** of Example 4 of the second embodiment.

In Example 4 illustrated in FIG. **38**, three elastic sheets are arranged so as to be superimposed such that elastic sheets having the same shape are used as the second and third elastic sheets **332***b* and **332***j* and an elastic sheet having a different shape from the second and third elastic sheets **332***b* and **332***j* is used as the first elastic sheet **332***a*. Although each of the second and third elastic sheets **332***b* and **332***j* having the same

shape is arranged so as to partially have an opening in relation to the front end opening **305**, since the elastic sheets are arranged so that the positions of the openings are different, the superimposed two elastic sheets cover the entire nozzle insertion opening **331**. Specifically, the second elastic sheet **332***b* is arranged so that the linear free end **432***b* of the second elastic sheet **332***b* is disposed at a position rotated by 180° in the counter-clockwise direction in FIG. **38** about the linear free end **432***j* of the third elastic sheet **332***j*.

Moreover, the first elastic sheet **332***a* has a donut shape that covers portions other than the center of the nozzle insertion opening **331**.

By using the two second and third elastic sheets **332***b* and **332***j* that cover the entire nozzle insertion opening **331** and the first elastic sheet **332***a* having a donut shape, the strength (closing force) of the sheet overlapping portion **332***c* is provided. By improving the strength (closing force) of the sheet overlapping portion **332***c*, it is possible to further prevent the toner leakage from the container opening **33***a* due to vibration during transportation.

Example 5

FIG. **39** is a diagram illustrating arrangement of three elastic sheets **332** of Example 5 of the second embodiment.

In Example 5 illustrated in FIG. **39**, similarly to the configuration illustrated in FIG. **38**, three elastic sheets are arranged so as to be superimposed such that elastic sheets having the same shape are used as the second and third elastic sheets **332***b* and **332***j* and an elastic sheet having a different shape from the second and third elastic sheets **332***b* and **332***j* is used as the first elastic sheet **332***a*. Although each of the second and third elastic sheets **332***b* and **332***j* having the same shape is arranged so as to partially have an opening in relation to the front end opening **305**, since the elastic sheets are arranged so that the positions of the openings are different, the superimposed two elastic sheets cover the entire nozzle insertion opening **331**. Specifically, the second elastic sheet **332***b* is arranged so that the linear free end **432***b* of the second elastic sheet **332***b* is disposed at a position rotated by 180° in the counter-clockwise direction in FIG. **39** about the linear free end **432***j* of the third elastic sheet **332***j*.

Moreover, the first elastic sheet **332***a* has a shape that covers the entire area of the nozzle insertion opening **331** and has a first slit **332***f* at the center of the nozzle insertion opening **331**.

By using the two second and third elastic sheets **332***b* and **332***j* that cover the entire nozzle insertion opening **331** and the first elastic sheet **332***a* having a slit, the strength (closing force) of the sheet overlapping portion **332***c* is provided. By improving the strength (closing force) of the sheet overlapping portion **332***c*, it is possible to further prevent the toner leakage from the container opening **33***a* due to vibration during transportation. When forming the slit, a round hole may be provided at both ends of the slit in order to prevent tearing of the elastic sheet **332**.

In the second embodiment illustrated in FIGS. **35** to **39**, the first, second, and third elastic sheets **332***a*, **332***b*, and **332***j* have different free ends **432** (**432***a*, **432***b*, and **432***j*). Moreover, a certain free end **432** overlaps with the surface portion of at least one of the other two elastic sheets **332**. At least two elastic sheets **332** overlap in the insertion direction of the conveying nozzle **611** in a portion between at least two free ends **432** of the three free ends **432**, and this overlapping portion configurates the sheet overlapping portion **332***c*. Due to this, the free end **432** that is displaced with insertion of the conveying nozzle **611** overlaps with the other elastic sheet **332** in the insertion direction of the conveying nozzle **611** before the conveying nozzle **611** is inserted.

FIG. **40** is a diagram illustrating a nozzle contact position **332***p* in Example 3 illustrated in FIG. **37**, at which the first elastic sheet **332***a* disposed on the outermost side first makes contact with the front end of the conveying nozzle **611**. As illustrated in FIG. **40**, approximately the central position of the circular cross-section of the nozzle insertion opening **331** is the nozzle contact position **332***p*. The same is true for the configuration described in other embodiments and examples without being limited to Example 3 of the second embodiment of FIG. **37**.

When the toner container **32** is attached to the toner replenishing device **60** and attachment is completed, the elastic sheets **332** are expanded by the front end of the conveying nozzle and are displaced by the diameter of the conveying nozzle. In this case, since the conveying nozzle **611** comes at the nozzle contact position **332***p* which is approximately the center of the circular cross-section of the nozzle insertion opening **331**, when the plurality of elastic sheets **332** has the same shape, the amount of displacement of the elastic sheets **332** is the same.

Example 6

FIG. **28** is a diagram illustrating arrangement of three elastic sheets **332** of Example 6 of the second embodiment. In Example 6 illustrated in FIG. **28**, another elastic sheet **332** having a round hole-shaped opening is added to Example 2 of the first embodiment in which two elastic sheets **332** having a round hole-shaped opening are superimposed. That is, a third elastic sheet **332***j* that has a shape that covers the entire nozzle insertion opening **331** and has a third round through-hole **332***k* provided in a portion thereof is added to Example 2 of the first embodiment. The other configuration except that the third elastic sheet **332***j* is added is the same as Example 2 of the first embodiment, and the same configuration will not be described.

As in the second embodiment, by using three elastic sheets, it is possible to improve the sealing property and to prevent the occurrence of toner leakage more reliably as compared to the configuration of the first embodiment that uses two elastic sheets **332**.

The superimposing methods of FIGS. **35** to **39** in the second embodiment were compared as to the occurrence of the leakage of toner stored in the toner container **32** when the toner container **32** was placed with the elastic sheet **332** on the lower side in the gravity direction. The comparison result showed that the superimposing method of Example 2 illustrated in FIG. **36** was best in making toner difficult to leak.

This is considered to be attributable to the fact that, when the load of toner is applied to the three superimposed elastic sheets **332**, the first elastic sheet **332***a* functions to press the second and third elastic sheets **332***b* and **332***j* that try to be open leftward and rightward in the figure.

When this function is taken into consideration, a belt-shaped or string-shaped first elastic sheet **332***a* may be used so that the belt-shaped or string-shaped elastic sheet **332***a* is disposed in the direction along which the second and third elastic sheets **332***b* and **332***j* try to be open due to the load of toner. In other words, the belt-shaped or string-shaped first elastic sheet **332***a* may be disposed so as to extend along the direction orthogonal to the direction of the free end **432** of the second or third elastic sheet **332***b* and **332***j*. Here, the free end **432** of the elastic sheet **332** is a portion which is not interposed between the attaching portion **337** and the sheet stopper **335**.

Moreover, the same effect can be obtained by applying tension to the first elastic sheet **332***a* in the direction along which the second and third elastic sheets **332***b* and **332***j* try to be opened due to the load of toner.

Moreover, as illustrated in FIG. **13**, the elastic sheet **332** is disposed at the same position (within the range of a gear width) as the container gear **301** in the insertion direction (the rotation axis direction of the toner container **32**) of the conveying nozzle **611** which is a powder conveying nozzle. This provides the following advantages.

As described above, three superimposed elastic sheets **332** are arranged so that the first elastic sheet **332***a* functions to press the second and third elastic sheets **332***b* and **332***j* that try to be opened leftward and rightward in the figure when the load of toner is applied. With this arrangement, even when the toner container **32** is placed so that the elastic sheet **332** faces the lower side in the gravity direction during transportation, toner can rarely leak.

However, when the first elastic sheet **332***a* is disposed in this manner, the reactive force of the restoring force is not cancelled when the conveying nozzle **611** is inserted so that the first elastic sheet **332***a* is displaced. This will be described in more detail using the directions illustrated in FIG. **36**. Since the conveying nozzle **611** is inserted at the center, the restoring force of the second elastic sheet **332***b* is generated in the rightward direction in the figure (that is, the direction in which the free end **432** returns to the original position), and thus, the reactive force of the restoring force is generated in the leftward direction. Similarly, since the restoring force of the third elastic sheet **332***j* is generated in the leftward direction in the figure (that is, the direction in which the free end **432** returns to the original position), the reactive force of the restoring force is generated in the rightward direction in the figure. Moreover, since the restoring force of the first elastic sheet **332***a* is generated in the upward direction in the figure, that is, in the direction in which the free end **432** returns to the original position, the reactive force of the restoring force is generated in the downward direction in the figure. The reactive force of the restoring force of these first to third elastic sheets **332***a* to **332***j* acts on the toner container **32**.

Here, although the reactive force of the restoring force of the second and third elastic sheets **332***b* and **332***j* is generated in an opposite direction and is cancelled, the reactive force of the restoring force of the first elastic sheet **332***a* is not cancelled but acts on the toner container **32**.

If the elastic sheet **332** is at a different position (outside the range of a gear width) from the container gear **301** in the insertion direction (the rotation axis direction of the toner container **32**) of the conveying nozzle **611**, the following problem occurs.

That is, the reactive force of the restoring force of the first elastic sheet **332***a* and the meshing force of the container driving output gear **601** which is a body-side gear that the container gear **301** receives with power transmission act on different positions in the insertion direction of the conveying nozzle **611**. This is not desirable because the force acts in a direction in which the toner container **32** is tilted in relation to the insertion direction (the rotation axis direction of the toner container **32**) of the conveying nozzle **611**.

When the toner container **32** rotates in a state of being tilted in relation to the conveying nozzle **611**, the sliding resistance between the outer circumferential surface of the container opening **33***a* and the container-setting-portion inner circumferential surface **615***a*, for example, increases, and it is necessary to change with a motor that can output a large torque. Further, a portion of the toner container **32** close to the knob **303** may bump against the toner container receiving portion **70** of the printer unit **100** to generate noise.

In contrast, in any Example of the second embodiment, as illustrated in FIG. **13**, the elastic sheet **332** is positioned at the same position (within the range of a gear width) of the container gear **301** in the insertion direction (the rotation axis direction of the toner container **32**) of the conveying nozzle **611**. Due to this, the reactive force of the restoring force of the first elastic sheet **332***a* and the meshing force of the container driving output gear **601** that the container gear **301** receives with power transmission act on the same position in the insertion direction (the rotation axis direction of the toner container **32**) of the conveying nozzle **611**. Thus, such an action that tilts the toner container **32** does not occur.

Third Embodiment

Hereinafter, a third embodiment of the present invention will be described with reference to the drawings. In the third embodiment, as for the configuration other than the toner container as a powder container, the configuration described in the first embodiment can be suitably used. Moreover, as for the method of superimposing the elastic sheets of the toner container, the configuration described in the first and second embodiments can be suitably used.

Hereinafter, a toner container **1032** according to the third embodiment of the present invention will be described with reference to FIG. **41**.

As the toner container **1032** illustrated in FIG. **41**, a configuration will be taken into consideration, in which the container body **33** is provided as a cylindrical member formed of a resin (this container body will be referred to as a container body **1033** for the convenience's sake to distinguish from the container body described in the previous embodiments) though the component cost increases as compared to the toner container **32** illustrated in FIG. **1** and other figures, and a scooping function is provided in a portion of the conveying member.

FIG. **41**(*a*) is a perspective view of a member in which a scooping rib **304***g* corresponding to the scooping wall surface **304***f* is integrated with the nozzle receiver **330** (will be referred to as a nozzle receiver **1330**). FIG. **41**(*b*) is a cross-sectional view illustrating a relation between the nozzle receiver **1330** of FIG. **41**(*a*) disposed inside the container body **1033** and the conveying nozzle **611**. FIG. **41**(*c*) is a side cross-sectional view illustrating the entire toner container **1032** on which the nozzle receiver **1330** illustrated in FIG. **41**(*a*) is mounted.

The nozzle receiver **1330** illustrated in FIG. **41** includes the scooping rib **304***g* as described above and is integrated with a conveying blade held portion **1330***b* to which a conveying blade **1302** formed of a flexible material such as a resin film is attached. The conveying blade **1302** and the conveying blade held portion **1330***b* correspond to a rotating conveyor.

Moreover, similarly to the previous embodiments, the nozzle receiver **1330** illustrated in FIG. **41** includes an attaching portion **1337** of the nozzle receiver **1330**, an elastic sheet **1332**, a container seal **1333** which is a container sealing member, a nozzle insertion opening **1331**, and a sheet stopper **1335**.

The sheet stopper **1335** includes a pair of extension portions **1335***a* and a portion on the container rear end side of the extension portion **1335***a* is connected to the conveying blade held portion **1330***b*. The elastic sheet **1332** is formed of a thin film sheet formed from an elastic material having flexibility and is superimposed in the superimposing method described in the previous embodiments. Moreover, in the toner con-

tainer **1032** of the present embodiment, the elastic sheet **1332** includes two elastic sheet members of first and second elastic sheets **1332***a* and **1332***b* so that the sheet members are disposed so as to overlap to configurate a sheet overlapping portion **1332***c*. Moreover, the sheet overlapping portion **1332***c* blocks a portion of the elastic sheet **1332** which is opened when the conveying nozzle **611** is expanded.

The attaching portion **1337** has such a cylindrical shape that the diameter of the inner circumferential surface decreases stepwise toward a container seal attached wall (serving as a seal attached portion) **1336** to be described later. As illustrated in FIG. **41**(*a*), the attaching portion **1337** has the donut-shaped container seal attached wall **1336** in which the diameter of the inner circumferential surface is smaller than the other portion in order to hold the elastic sheet **1332** and the container seal **1333**.

The donut-shaped container seal **1333** is disposed so as to make contact with a wall surface which is on the front end side in relation to the container seal attached wall **1336**. The container seal **1333** is attached to the wall surface (first wall surface) on the front end side of the container seal attached wall **1336** of the attaching portion **1337** by an adhesive agent, a double-sided tape, or the like.

Further, in the configuration illustrated in FIG. **41**, the nozzle receiver **1330** has an outer circumferential surface **1330***a* that is slidably fitted to the container-setting-portion inner circumferential surface **615***a* on the body side of the copying machine **500**. The nozzle receiver **1330** is attached to a container gear **1301** as a separate member so that power can be transmitted.

In this manner, the configuration of allowing toner present in the scooping inner wall surface, the relaying portion, and an extension-portion opening **1335***b* to flow into the nozzle opening **610** can be integrated.

Next, the details of the toner container **1032** including the scooping rib **304***g* will be described.

As illustrated in FIG. **41**(*c*), the toner container **1032** includes a container front end cover **1034**, a container body **1033**, a bottom lid **1035**, and a nozzle receiver **1330**. The container front end cover **1034** is disposed on the front end side in the direction of attaching the toner container **1032** to the body of the copying machine **500**, and the container body **1033** has an approximately cylindrical shape. The bottom lid **1035** is disposed on the rear end side in the attachment direction of the toner container **1032**, and the nozzle receiver **1330** is rotatably held in the approximately cylindrical container body **1033**.

A gear exposing opening **1034***a* (the same opening as the gear exposing opening **34***a*) for exposing the container gear **1301** attached to the nozzle receiver **1330** is provided in the container front end cover **1034**. The approximately cylindrical container body **1033** rotatably holds the nozzle receiver **1330**, and the container front end cover **1034** and the bottom lid **1035** are attached (by a well-known method such as welding or an adhesive agent). The bottom lid **1035** has a rear-end-side bearing **1035***a* that supports one end of the conveying blade held portion **1330***b* and has a knob **1303** for allowing a user to grasp when attaching the toner container **1032** to the body of the copying machine **500**.

Next, a method of assembling the container front end cover **1034**, the bottom lid **1035**, and the nozzle receiver **1330** into the container body **1033** will be described.

First, the nozzle receiver **1330** is inserted into the container body **1033** from the container rear end side so as to be aligned with respect to a front-end-side bearing **1036** located on the front end side of the container body **1033** so that the nozzle receiver **1330** is rotatably supported. Subsequently, the rear-end-side bearing **1035***a* provided in the bottom lid **1035** is aligned so as to rotatably support one end of the conveying blade held portion **1330***b* of the nozzle receiver **1330**, and the bottom lid **1035** is attached to the container body **1033**. After that, the container gear **1301** is attached to the nozzle receiver **1330** from the container front end side. After the container gear **1301** is attached, the container front end cover **1034** is attached to the container body **1033** in such a manner to cover the container gear **1301** from the container front end side.

As for the fixing of the container body **1033** and the container front end cover **1034**, the fixing of the container body **1033** and the bottom lid **1035**, and the fixing of the nozzle receiver **1330** and the container gear **1301**, a well-known method (for example, welding, an adhesive agent, or the like) can be used appropriately.

Next, a configuration of conveying toner from the toner container **1032** to the nozzle opening **610** will be described.

The scooping rib **304***g* protrudes from an end **1335***c* on the downstream side in the rotation direction of the shutter side surface supporting portion **1335***a* up to the vicinity of the inner circumferential surface of the container body **1033** so that the rib surfaces are connected. Although the rib surface is bent halfway to have a shape close to a curved surface, the rib surface is not limited to this configuration depending on the affinity to toner, and a simply planar rib without any bent portion may be used. Due to such a configuration, it is not necessary to form a bulging portion on the container body **1033**. Further, since the scooping rib **304***g* is erected integrally from the extension-portion opening **1335***b*, the same relaying function as described in the previous embodiment can be obtained. That is, when the nozzle receiver **1330** rotates when the toner container **1032** is attached to the body of an image forming apparatus, the conveying blade rotates and the toner stored in the toner container **1032** is conveyed from the rear end side toward the front end side where the nozzle receiver **1330** is disposed. Moreover, the scooping rib **304***g* receives the toner conveyed by the conveying blade **1302** and scoops the toner from the lower side to the upper side with rotation, and the toner can be flowed into the nozzle opening **610** using the rib surface as a sliding bed.

Fourth Embodiment

Hereinafter, a fourth embodiment of the present invention will be described with reference to the drawings. In the fourth embodiment, the same members or members having the same functions as those of the first, second, and third embodiments will be denoted by the same reference numerals, and the description thereof may sometimes be omitted. In the fourth embodiment, as for the configuration other than the toner container as the powder container, the configuration described in the first embodiment can be suitably used. As for the method of superimposing the elastic sheets of the toner container, the configuration described in the first and second embodiments can be suitably used. Moreover, the toner container described in the third embodiment can be used as the powder container.

Example 1

Next, characteristic features of the toner container **32** according to Example 1 of the fourth embodiment will be described.

As illustrated in FIG. **42**, the toner container **32** includes a container body **33** as a container body, a nozzle receiver **330** as a nozzle insertion portion, and a cap **370** as a sealing member. Moreover, the nozzle receiver **330** includes an

attaching portion **337** of the nozzle receiver **330**, a container seal **333**, an elastic sheet **332**, and a sheet stopper **335**. Moreover, the cap **370** includes a columnar member **373** that makes contact with the elastic sheet **332** in a state of being attached to the container body **33**. The columnar member **373** serves as a contact portion.

The container body **33** is a powder storage member that forms a container body that stores toner which is powder therein, and the nozzle receiver **330** includes the nozzle insertion opening **331** provided in an opening on the other end side of the container body **33**. Moreover, the container seal **333** formed from an elastic body is a member that defines the vicinity of the other end of the nozzle insertion opening **331** and is a member that seals the space between the nozzle receiver **330** and the conveying nozzle **611**.

Moreover, the elastic sheet **332** is an opening blocking member that blocks the nozzle insertion opening **331**, and the cap **370** is a sealing member that seals an opening on the other end side that serves as a powder discharge side, of the container body **33**. The columnar member **373** has such a shape that two columns of which the imaginary lines passing the center are identical and the radii from the imaginary circular lines of the cross-sections are different are stacked. The columnar member **373** includes a contact portion of which the front end makes contact with the elastic sheet **332** to suppress elastic deformation of the elastic sheet **332** resulting from vibration.

Here, a side of the cap **370** making contact with the elastic sheet **332** in a state of being attached to the container body **33** will be referred to as a one end side and a side opposite to one end side and facing the outer side will be referred to as the other end side.

Since the columnar member **373** is in contact with the elastic sheet **332**, even when vibration or impact is applied to the toner container **32** so that vibration or impact is transmitted to the elastic sheet **332**, it is possible to suppress elastic deformation resulting from the vibration or impact. By suppressing elastic deformation, it is possible to suppress a gap from being provided in a portion of the nozzle insertion opening **331** blocked by the elastic sheet **332** resulting from vibration or impact. Since the formation of a gap can be suppressed, it is possible to suppress toner stored in the container body **33** from reaching a space between the cap **370** and the elastic sheet **332** in a state where the cap **370** is attached. Due to this, it is possible to suppress the leakage of toner when the cap **370** is detached from the toner container **32**.

As an elastic deformation of the elastic sheet **332**, the portion expanded by the conveying nozzle **611** may be displaced toward the outside (the front end side) in relation to the container body **33** and may be displaced toward the inside (the rear end side) of the container body **33**. In the elastic deformation where the portion expanded by the conveying nozzle **611** is displaced toward the outside (the front end side), the columnar member **373** of the cap **370** makes contact with the elastic sheet **332** from the outer side, whereby the elastic sheet **332** that tries to be elastically deformed bumps against the columnar member **373**. Thus, elastic deformation can be suppressed. On the other hand, in the elastic deformation where the expanded portion is displaced toward the inside (the rear end side) of the container body **33**, since the portion is displaced away from the columnar member **373**, it is not possible to suppress the elastic deformation by contact. However, the energy that elastically deforms the elastic sheet **332** with vibration or impact is also transmitted and distributed to the columnar member **373** that makes contact with the elastic sheet **332**. Moreover, after the elastic sheet **332** is displaced toward the inner side, since the elastic sheet **332** may return to the outer side due to the restoring force, it is possible to decrease the amount of displacement of the elastic sheet **332** during elastic deformation as compared to the configuration where the columnar member **373** is not provided. Moreover, when the amount of displacement of the elastic sheet **332** is decreased, even if a gap is provided due to vibration or impact, the size of the gap is small as compared to the configuration where the columnar member **373** is not provided. Thus, it is possible to suppress toner stored in the container body **33** from reaching the space between the cap **370** and the elastic sheet **332**.

Depending on a contact state of the elastic sheet **332** and the columnar member **373**, a gap through which powder such as toner leaks may be provided in the elastic sheet **332**. Thus, it is necessary to appropriately set the shape, the size, and the like of the columnar member **373** and the elastic sheet **332** so that the columnar member **373** as a contact portion and the elastic sheet **332** as an opening blocking member are in a reliable contact state.

Specifically, as illustrated in FIG. **42**, the configuration of the nozzle receiver or the like that holds the elastic sheet **332** or the shape and size or the like of the columnar member **373** may be adjusted so that the entire surface of the columnar member **373** makes contact with the elastic sheet **332**.

In the present embodiment, the elastic sheet **332** is made up of two elastic sheet members similarly to the configuration described in the first embodiment, and the two elastic sheet members are partially superimposed to configurate a nozzle insertion opening that can receive the conveying nozzle **611** therein. Moreover, the elastic sheet **332** functions as an opening blocking member that blocks the nozzle insertion opening. Since the overlapping portion of the two elastic sheet members makes contact with the columnar member **373**, such a gap through which powder such as toner can leak will be rarely provided.

The overlapping portions of the two elastic sheet members are elastically deformed, whereby the nozzle insertion opening is provided.

Moreover, the position of the elastic sheet **332** with which the columnar member **373** makes contact is a portion in which the elastic sheet **332** is elastically deformed due to vibration or impact and a gap through which toner in the container body **33** can pass can be provided. In an end portion (the portion near the fixed portion) of the elastic sheet **332** in the direction orthogonal to the insertion direction of the conveying nozzle **611**, strong interposing force is applied by the sheet stopper **335** of the nozzle receiver **330** and the attaching portion **337**, and thus, the end portion is rarely elastically deformed by vibration or impact. Thus, if the columnar member **373** makes contact with this portion only, the effect of suppressing formation of a gap resulting from vibration or impact is small.

In Example 1 of the present embodiment, the front end of the columnar member **373** makes contact with the overlapping portion of the two elastic sheets **332**. In this portion, the overlapping portion disappears when the elastic sheet **332** is elastically deformed due to vibration or impact, and a gap through which toner can pass can be provided. By allowing the columnar member **373** to make contact with such a portion, it is possible to suppress a gap through which toner can pass from being provided in the elastic sheet **332**.

In the configuration of JP 07-261492 A in which a slit is provided in a sheet-shaped opening blocking member and a powder conveying nozzle is inserted by expanding the slit, the same effect can be obtained by allowing a contact portion to make contact with this slit. This is because, as described above, elastic deformation can be suppressed in the case where the opening blocking member is displaced toward the

outside in relation to the container body and the case where the opening blocking member is displaced toward the container body.

In the toner container **32** according to Example 1 of the present embodiment, it is possible to suppress toner in the container body **33** from reaching the space between the cap **370** and the elastic sheet **332** due to vibration or impact. Thus, when the cap **370** is detached from the toner container **32**, since no toner adheres to the outer surface of the elastic sheet **332**, it is possible to prevent toner from falling or scattering. Therefore, it is possible to suppress the occurrence of toner leakage resulting from vibration or dropping during transportation of the toner container **32**.

In the toner container **32** illustrated in FIG. **42**, the columnar member **373** and the cap **370** are formed of different materials, and the other end side (the left side in FIG. **42**) of the columnar member **373** is attached to the cap **370** using an adhesive agent or the like. Further, as illustrated in FIG. **1**, in a state where the cap **370** is attached to the toner container **32**, the end surface on one end side (the right side in FIG. **42**) of the columnar member **373** makes contact with the front end surface of the elastic sheet **332**.

The columnar member **373** has such a shape that two columns having different diameters are stacked in a direction from the other end side to one end side and includes a base-end-side columnar portion **373***b* having a larger diameter and a front-end-side columnar portion **373***a* having a smaller diameter. The diameter of the front-end-side columnar portion **373***a* is smaller than the diameter of the donut-shaped inner circumferential surface of the container seal **333**. Moreover, the diameter of the base-end-side columnar portion **373***b* is larger than the diameter of the donut-shaped inner circumferential surface of the container seal **333** and is smaller than the outer diameter (the diameter of the outer circumferential surface) of the container seal **333**.

Due to such a configuration, in a state where the cap **370** is attached to the toner container **32**, the end surface on one end side of the front-end-side columnar portion **373***a* makes contact with the elastic sheet **332**. Further, the end surface (an end surface that forms a step in relation to the front-end-side columnar portion **373***a*) on one end side of the base-end-side columnar portion **373***b* makes contact with the end surface on the other end side of the container seal **333**. When the base-end-side columnar portion **373***b* of the columnar member **373** makes contact with the end surface on the other end side of the container seal **333**, the other end of the nozzle insertion opening **331** defined by the container seal **333** can be sealed by the end surface of the base-end-side columnar portion **373***b*. Due to this, it is possible to directly seal the nozzle insertion opening **331** and to prevent a gap from being provided in the elastic sheet **332** due to vibration or impact. Moreover, even if a gap is provided in the elastic sheet **332**, it is possible to prevent the occurrence of toner leakage.

As described above, in the toner container **32** illustrated in FIG. **42**, the columnar member **373** is formed of a member different from the cap **370**. Thus, the cap **370** can be formed of a different material from the columnar member **373** in such a manner that the cap **370** is formed of an inexpensive resin such as a polystyrene resin and the columnar member **373** is formed of a highly flexible material such as rubber or sponge. When the columnar member **373** is formed of a highly flexible material, the adhesion during contact between the columnar member **373** and the end surface on the other end side of the elastic sheet **332** and the container seal **333** is improved. Thus, it is possible to prevent the toner leakage resulting from impact due to vibration or dropping more effectively.

Moreover, since the cap **370** itself can be formed of an inexpensive resin such as polystyrene resin different from the material of the columnar member **373**, it is possible to decrease the cost while maintaining the toner leakage preventing function of the columnar member **373**.

As described above, the elastic sheet **332** made up of two elastic sheet members is formed of an elastic material (for example, rubber material such as silicone rubber) having flexibility and is assembled in a state of being slightly expanded to be longer than its natural length, in other words, small tension is applied. In the present embodiment, it is preferable that the columnar member **373** makes contact with the elastic sheet **332** so as to slightly enter therein. Specifically, it is preferable that the columnar member **373** makes contact with the elastic sheet **332** so that the elastic sheet **332** is slightly displaced inward further than the state where the columnar member **373** is not in contact therewith. By realizing such contact, tension is applied to the elastic sheet **332**, and the adhesion (air-tightness) of the two elastic sheets **332** in the overlapping portion is improved. Thus, it is possible to prevent toner leakage more effectively, and satisfactory characteristics against vibration and impact are obtained.

The cap **370** of the present embodiment can be similarly applied to the configuration that uses three elastic sheet members in the third embodiment.

In the configuration disclosed in JP 07-261492 A, the opening blocking member corresponds to a configuration in which a slit is provided in one elastic sheet member. In such a configuration, when a contact portion such as the columnar member **373** makes contact with the elastic sheet member, the elastic sheet member is displaced slightly toward the inner side in the rotation axis direction, which acts to open the slit, and toner can easily leak.

On the other hand, in the toner container **32** according to Example 1 of the present embodiment, the opening blocking member is arranged so as to overlap with the two elastic sheets **332**. Due to such an arrangement, when the conveying nozzle **611** is inserted, the two elastic sheets **332** are expanded so that the overlap is removed, and the conveying nozzle **611** can be inserted. During storage, the two elastic sheets **332** forms an overlapping portion, and the columnar member **373** makes contact with the overlapping portion to cause the elastic sheet **332** to be displaced slightly inward. However, since this contact does not remove the overlap, a gap through which toner can leak is not provided.

Further, when the columnar member **373** makes contact with the elastic sheet **332** to elastically deform the elastic sheet **332**, elastic force acts from the elastic sheet **332** in such a manner that the columnar member **373** is pushed back. Due to this, it is possible to enhance the adhesion in the overlapping portion of the two elastic sheet members and to prevent leakage of toner more reliably.

In the toner container **32** according to Example 1 of the present embodiment, since the two elastic sheet members maintain the overlapping portion even when the cap **370** is detached, it is possible to suppress toner leakage. In the toner replenishing device **60** including such a toner container **32**, it is possible to suppress leakage of toner when the cap **370** of a new toner container **32** is detached when the toner container **32** is replaced. Thus, it is possible to suppress the occurrence of contamination inside the device and contamination outside the device resulting from the leakage of toner.

Moreover, in the copying machine **500** including such a toner replenishing device **60**, it is possible to suppress the occurrence of contamination inside the device and contamination outside the device when the toner container **32** is replaced.

Example 2

Next, the configuration according to Example 2 of the toner container **32** in which a contact portion is provided in a sealing member such as the cap **370** of the fourth embodiment will be described.

FIG. **43** is a cross-sectional view illustrating the toner container **32** of Example 2.

The toner container **32** of Example 2 is different from the toner container **32** of FIG. **42** that includes the columnar member **373** formed of a different member from the cap **370** in that a columnar portion **374** formed integrally with the cap **370** is provided as a contact portion.

The toner container **32** of Example 2 includes the columnar portion **374** that makes contact with the elastic sheet **332**. Thus, similarly to the toner container **32** illustrated in FIG. **42**, it is possible to suppress toner stored in the container body **33** from reaching a space between the cap **370** and the elastic sheet **332** in a state where the cap **370** is attached. Due to this, it is possible to suppress the leakage of toner when the cap **370** is detached from the toner container **32**.

The columnar portion **374** has such a shape that two columns having different diameters are stacked in a direction from the other end side to one end side and includes a base-end-side columnar portion **374***b* having larger diameter and a front-end-side columnar portion **374***a* having a smaller diameter. The diameter of the front-end-side columnar portion **374***a* is smaller than the diameter of the donut-shaped inner circumferential surface of the container seal **333**. Moreover, the diameter of the base-end-side columnar portion **374***b* is larger than the diameter of the donut-shaped inner circumferential surface of the container seal **333** and is smaller than the outer diameter (the diameter of the outer circumferential surface) of the container seal **333**.

Due to such a configuration, in a state where the cap **370** is attached to the toner container **32**, the end surface on one end side of the front-end-side columnar portion **374***a* makes contact with the elastic sheet **332**. Further, the end surface (an end surface that forms a step in relation to the front-end-side columnar portion **374***a*) on one end side of the base-end-side columnar portion **374***b* makes contact with the end surface on the other end side of the container seal **333**. When the base-end-side columnar portion **374***b* of the columnar portion **374** makes contact with the end surface on the other end side of the container seal **333**, the other end of the nozzle insertion opening **331** defined by the container seal **333** can be sealed by the end surface of the base-end-side columnar portion **374***b*. Due to this, it is possible to directly seal the nozzle insertion opening **331** and to prevent a gap from being provided in the elastic sheet **332** due to vibration or impact. Moreover, even if a gap is provided in the elastic sheet **332**, it is possible to prevent the occurrence of toner leakage. In this manner, in the toner container **32** of Example 2 of the first embodiment, it is possible to suppress the occurrence of toner leakage resulting from vibration or dropping during transportation of the toner container **32**. Moreover, since the columnar portion **374** can be formed (molded) integrally with a portion of the cap **370**, it is possible to reduce the cost.

Moreover, similarly to the columnar member **373** of the toner container **32** according to Example 1 illustrated in FIG. **42**, it is preferable that the columnar portion **374** of the cap **370** of Example 2 makes contact with the elastic sheet **332** so as to slightly enter therein. Specifically, it is preferable that the columnar portion **374** makes contact with the elastic sheet **332** so that the elastic sheet **332** is slightly displaced inward when the columnar portion **374** makes contact therewith. By realizing such contact, tension is applied to the elastic sheet **332**, and the adhesion (air-tightness) of the two elastic sheets **332** in the overlapping portion is improved. Thus, it is possible to prevent toner leakage more effectively, and satisfactory characteristics against vibration and impact are obtained.

In this way, the toner container **32** of Example 2 can provide the same advantages as the toner container **32** according to Example 1 of FIG. **42**.

Example 3

Next, the configuration according to Example 3 of the toner container **32** in which a contact portion is provided in a sealing member such as the cap **370** of the fourth embodiment will be described.

FIG. **44** is a cross-sectional view illustrating the toner container **32** of Example 3 of the present embodiment.

The toner container **32** of Example 3 includes the columnar portion **374** that is formed integrally with the cap **370** as the contact portion similarly to Example 2. The toner container **32** of Example 3 is different from the toner container **32** of Example 2 in that a front end columnar elastic member **375** formed of a highly flexible material such as rubber or sponge is provided on the front end surface of the columnar portion **374**.

The toner container **32** of Example 3 includes the columnar portion **374** that makes contact with the elastic sheet **332**. Thus, similarly to the toner container **32** of Examples 1 and 2, it is possible to suppress toner stored in the container body **33** from reaching a space between the cap **370** and the elastic sheet **332** in a state where the cap **370** is attached. Due to this, it is possible to suppress the leakage of toner when the cap **370** is detached from the toner container **32**.

Moreover, since the toner container **32** of Example 3 includes the columnar portion **374** having the same shape as the toner container **32** of Example 2 of the first embodiment, it is possible to directly seal the nozzle insertion opening **331**. Due to this, it is possible to prevent a gap from being provided in the elastic sheet **332** due to vibration or impact. Moreover, even if a gap is provided in the elastic sheet **332**, it is possible to prevent the occurrence of toner leakage. Thus, in the toner container **32** of Example 3, it is possible to suppress the occurrence of toner leakage resulting from vibration or dropping during transportation of the toner container **32**.

Further, in the toner container **32** of Example 3, the front end columnar elastic member **375** is provided on the end surface on one end side of the front-end-side columnar portion **374***a* of the columnar portion **374**. Due to this, when the front end columnar elastic member **375** makes contact with the elastic sheet **332**, the adhesion with the elastic sheet **332** is improved further than the toner container **32** of Example 2.

Specifically, the elastic sheet **332** can be displaced inward further by the amount corresponding to the thickness of the front end columnar elastic member **375**. Due to this, in the toner container **32** according to Example 1 of FIG. **42** and the toner container **32** of Example 2, the tension applied to the elastic sheet **332** can be finely adjusted by the thickness of the front end columnar elastic member **375**. Although a very small concave-convex surface corresponding to the thickness of the elastic sheet **332** is provided in the overlapping portion of the elastic sheet **332**, the front end columnar elastic member **375** itself has elasticity. Thus, since elastic deformation can occur following the concave-convex surface, it is possible to further improve the adhesion between the columnar portion **374** of the cap **370** and the elastic sheet **332**.

In order to apply tension to the elastic sheet **332**, it is preferable that the columnar portion **374** is formed of a mobile terminal that is rarely deformed as compared to the

elastic sheet **332**. However, if such a material is used, it is not possible to obtain the ability to follow the shape of the overlapping portion. Thus, the front end columnar elastic member **375** is provided on the columnar portion **374**. With such a configuration, by applying tension to the elastic sheet **332**, it is possible to obtain the ability to follow the shape of the overlapping portion of the elastic sheet **332**.

In Example 3, it is possible to prevent the toner leakage resulting from impact due to vibration or dropping more effectively.

Example 4

Next, the configuration according to Example 4 of the toner container **32** in which a contact portion is provided in a sealing member such as the cap **370** of the fourth embodiment will be described.

FIG. **45** is a cross-sectional view illustrating the toner container **32** of Example 4. The toner container **32** of Example 4 includes the columnar portion **374** that is formed integrally with the cap **370** as the contact portion similarly to Example 2. The toner container **32** of Example 4 is different from the toner container **32** of Example 2 in that an adsorbent **372** is provided inside the columnar portion **374** so as to be open to the outside, that is, in a state of being exposed to the outside air.

Since the toner container **32** of Example 4 has the adsorbent **372** added to the toner container **32** of Example 2, satisfactory characteristics against vibration and impact are obtained similarly to the toner container **32** of Example 2. That is, the toner container **32** of Example 4 includes the columnar portion **374** that makes contact with the elastic sheet **332**. Thus, similarly to the toner container **32** of Example 2, it is possible to suppress toner stored in the container body **33** from reaching a space between the cap **370** and the elastic sheet **332** in a state where the cap **370** is attached. Due to this, it is possible to suppress the leakage of toner when the cap **370** is detached from the toner container **32**. Moreover, since the columnar portion **374** can be formed (molded) integrally with a portion of the cap **370**, it is possible to reduce the cost.

Further, the toner container **32** of Example 4 includes the adsorbent **372**.

Example 4 is the toner container **32** that uses an adsorbent such as a drying agent during storage. The adsorbent adsorbs various substances (gas or the like) without limiting to moisture. Thus, a drying agent is included in an adsorbent. Examples of the adsorbent include silica gel, aluminum oxide, zeolite, and the like, and any agent having adsorbing capability may be used.

In the toner container **32** of Example 4, since the adsorbent **372** is provided in the columnar portion **374** provided in the cap **370**, the adsorbent **372** can be removed together with the cap **370** when the cap **370** is detached during use. Thus, the operability is improved.

In the toner container **32** of Example 4, when the toner container **32** is transported in a state of being packaged with the cap **370** attached, since the adsorbent **372** is exposed to the outside air around the toner container **32**, it is possible to absorb moisture around the toner container **32** in the package.

In Example 4, the contact portion in which the adsorbent **372** exposed to the outside air is provided is the columnar portion **374** that is formed integrally with the cap **370**. However, the contact portion having such adsorbent **372** therein is not limited to the configuration illustrated in FIG. **45**, and the contact portion may be formed of a different member from the cap **370** similarly to the columnar member **373** of the toner container **32** illustrated in FIG. **42**.

Example 5

Next, the configuration according to Example 5 of the toner container **32** in which a contact portion is provided in a sealing member such as the cap **370** of the fourth embodiment will be described.

FIG. **46** is a cross-sectional view illustrating the toner container **32** of Example 5. The toner container **32** of Example 5 includes the columnar portion **374** that is formed integrally with the cap **370** as the contact portion similarly to Example 2. The toner container **32** of Example 4 is different from the toner container **32** of Example 2 in that an adsorbent **372** is disposed in the columnar portion **374** so as to adsorb a target substance in the space sealed by the cap **370**.

Since the toner container **32** of Example 5 has the adsorbent **372** added to the toner container **32** of Example 2, satisfactory characteristics against vibration and impact are obtained similarly to the toner container **32** of Example 2. That is, the toner container **32** of Example 5 includes the columnar portion **374** that makes contact with the elastic sheet **332**. Thus, similarly to the toner container **32** of Example 2 of the first embodiment, it is possible to suppress toner stored in the container body **33** from reaching a space between the cap **370** and the elastic sheet **332** in a state where the cap **370** is attached. Due to this, it is possible to suppress the leakage of toner when the cap **370** is detached from the toner container **32**.

Moreover, in the toner container **32** according to Example 5 illustrated in FIG. **46**, an adsorbing hole **374***c* as an opening is provided in a side surface of the columnar portion **374** so that gas or the like generated from toner itself is adsorbed by the adsorbent. The space where the adsorbing hole **374***c* is disposed communicates with the space sealed by the cap **370**.

Here, when the container body **33** is completely sealed by the cap **370**, since entering of air or moisture can be prevented, the adsorbent is not necessary, and as a result, a packaging material is not required. In this method, it is possible to reduce a packaging material such as a pouch, a cushioning material, or an individual packing box for packing the toner container **32** and to reduce the size of the package. Thus, it is possible to reduce an environmental load by reducing the materials uses.

However, the present inventors have found that toner itself which is powder generated gas to produce an aggregate which is a small lump of toner although the gas did not condense or solidify. Since such an aggregate can generate an abnormal image such as a white spot or spots of respective colors, it is necessary to suppress the occurrence of the aggregate. Although the container body **32** may be sealed without providing the adsorbent as illustrated in FIGS. **42**, **43**, and **44** unless toner itself does not generate gas, it is preferable that the toner container **32** that stores toner that generates gas by itself has an adsorbent that adsorbs gas.

Since the toner container **32** of Example 5 has the adsorbent **372**, it is possible to prevent air or moisture from entering into the toner container **32**. Moreover, since the adsorbent **372** is provided in the columnar portion **374** provided in the cap **370**, the adsorbent **372** can be removed together with the cap **370** by detaching the cap **370** when using the toner container **32**. Thus, the operability is improved.

Moreover, in the toner container **32** of Example 5, since the space (the inner space of the container body **33**) that stores toner is completely sealed by the cap **370**, it is possible to prevent air or moisture from entering into the toner storage

space. Further, since the space where the adsorbing hole **374***c* is disposed communicates with the space that is sealed by the cap **370**, it is possible to adsorb gas generated from the toner itself, and the adsorbing performance is improved as compared to the configuration of Example 4. Moreover, since the toner storage space (the inner space of the container body **33**) is sealed and the adsorbent **372** is provided in this sealed space, the toner and the adsorbent **372** are not affected by the outside air around the toner container **32**. Thus, a packaging material is not required.

In Example 5, the contact portion in which the adsorbent **372** disposed so as to adsorb a target substance in the space sealed by the cap **370** is provided is the columnar portion **374** that is formed integrally with the cap **370**. However, the contact portion having such adsorbent **372** therein may be formed of a different member from the cap **370** similarly to the columnar member **373** of the toner container **32** illustrated in FIG. **42**.

Moreover, in the toner container **32** according to the fourth embodiment illustrated in FIGS. **42** to **46**, a screw method is employed as a method of attaching the cap **370** which is a sealing member. An optional method such as a screw method or a hook method may be used as a method of attaching the cap **370** to the toner container **32** is not particularly limited as long as the cap **370** can be attached.

The above-described embodiments are examples, and the following aspects of the present invention provide characteristic advantages.

Aspect A

A powder container (for example, the toner container **32**), including: a container body (for example, the container body **33**) that stores a powder (for example, toner) to be supplied to a powder conveying device (for example, the toner replenishing device **60**); a nozzle insertion portion (for example, the nozzle receiver **330**) having a nozzle insertion opening (for example, the nozzle insertion opening **331**) through which a powder conveying nozzle (for example, the conveying nozzle **611**) of the powder conveying device is inserted into the container body; and an elastic sheet member (for example, the elastic sheet member **300**) formed of a sheet-shaped elastic body (for example, the elastic sheet **332**), which blocks the nozzle insertion opening in a state where the powder conveying nozzle is not inserted, and is elastically deformed so that the powder conveying nozzle can pass through a blocked portion of the nozzle insertion opening when the powder conveying nozzle is inserted, wherein the elastic sheet member is formed using a plurality of sheet-shaped elastic bodies, and at least a part of the plurality of elastic bodies is arranged so as to overlap at least partly in at least a diametric direction of the nozzle insertion opening in an insertion direction of the powder conveying nozzle.

According to this aspect, as described in the above embodiments, such a gap that a powder can pass through is rarely provided as compared to a configuration that includes the conventional elastic sheet member in which the nozzle insertion opening is blocked by one sheet-shaped elastic body. Thus, it is possible to suppress leakage of powder better than a powder container including the conventional elastic sheet member.

Aspect B

In Aspect A, three sheet-shaped elastic bodies (for example, the elastic sheets **332**) are used as the elastic sheet member (for example, the elastic sheet member **300**).

According to this aspect, as described in the second embodiment, it is possible to improve the sealing property further than the configuration in which the elastic sheet member is made up of two sheet-shaped elastic bodies and to prevent the occurrence of toner leakage more reliably.

Aspect C

In Aspect B, the sheet-shaped elastic bodies (for example, the elastic sheets **332**) have the same shape.

According to this aspect, as described in the second embodiment, since the sheet-shaped elastic bodies having the same shape are used, it is possible to further reduce the cost of the powder container.

Aspect D

In Aspect C, the sheet-shaped elastic body (for example, the elastic sheet **332**) has a held portion (for example, the interposing portion **3321**) that is held on the nozzle insertion portion (for example, the nozzle receiver **330**) and an end portion (for example, the free end **432**) that is not held, and an entire area of the end portion disposed to overlap another sheet-shaped elastic body to cover the entire nozzle insertion opening (for example, the nozzle insertion opening **331**), and the three sheet-shaped elastic bodies are arranged so that an end portion (for example, the free ends **432***b* and **432***a*) of another sheet-shaped elastic body (the second and first elastic sheets **332***b* and **332***a*) is disposed at an angle of approximately 120° in a clockwise or counter-clockwise direction using the end portion (for example, the free end **432***j*) of one of the three sheet-shaped elastic bodies as a reference (for example, the third elastic sheet **332***j*).

According to this aspect, as described in the second embodiment, since three sheet-shaped elastic bodies can be arranged in a well-balanced manner, it is possible to further reduce toner scattering.

Aspect E

In Aspect C, the sheet-shaped elastic body (for example, the elastic sheet **332**) has a held portion (for example, the interposing portion **3321**) that is held on the nozzle insertion portion (for example, the nozzle receiver **330**) and an end portion (for example, the free end **432**) that is not held, and an entire area of the end portion disposed to overlap another sheet-shaped elastic body to cover the entire nozzle insertion opening (for example, the nozzle insertion opening **331**), and the three sheet-shaped elastic bodies are arranged so that an end portion (for example, the free end **432***b*) of another sheet-shaped elastic body (for example, the second elastic sheet **332***b*) is disposed at an angle of approximately 180° in a clockwise or counterclockwise direction using an end portion (for example, the free end **432***j*) of one of the three sheet-shaped elastic bodies as a reference (for example, the third elastic sheet **332***j*), and an end portion (for example, the free end **432***a*) of still another sheet-shaped elastic body (for example, the first elastic sheet **332***a*) is disposed at an angle of approximately 90° in a clockwise or counter-clockwise direction.

According to this aspect, as described in the second embodiment, one sheet-shaped elastic body is rotated by 90° to provide strength (closing force) of the overlapping portion (for example, the overlapping portion **332***c*). Due to this, it is possible to further prevent the toner leakage from the con-

tainer opening (for example, the container opening **33***a*) due to vibration during transportation.

Aspect F

In Aspect C, the sheet-shaped elastic body (for example, the elastic sheet **332**) has a held portion (for example, the interposing portion **3321**) that is held on the nozzle insertion portion (for example, the nozzle receiver **330**) and an end portion (for example, the free end **432**) that is not held, and an entire area of the end portion disposed to overlap another sheet-shaped elastic body to cover the entire nozzle insertion opening (for example, the nozzle insertion opening **331**), and the three sheet-shaped elastic bodies are arranged so that an end portion (for example, the free end **432***b*) of another sheet-shaped elastic body (for example, the second elastic sheet **332***b*) is disposed at an angle of approximately 180° in a clockwise or counterclockwise direction using an end portion (for example, the free end **432***j*) of one of the three sheet-shaped elastic bodies as a reference (for example, the third elastic sheet **332***j*), and an end portion (for example, the free end **432***a*) of still another sheet-shaped elastic body (for example, the first elastic sheet **332***a*) is disposed to overlap the end portion (for example, the free end **432***j*) of the one sheet-shaped elastic body serving as a reference (for example, the third elastic sheet **332***j*).

According to this aspect, as described in the second embodiment, three sheet-shaped elastic bodies are sequentially superimposed to provide the strength (closing force) of the overlapping portion (for example, the sheet overlapping portion **332***c*). Due to this, it is possible to further prevent the toner leakage from the container opening (for example, the container opening **33***a*) due to vibration during transportation.

Aspect G

In Aspect B, the elastic sheet member (for example, the elastic sheet member **300**) includes two sheet-shaped elastic bodies (for example, the second and third elastic sheets **332***b* and **332***j*) having the same shape and a sheet-shaped elastic body (for example, the first elastic sheet **332***a*) having a different shape from the two sheet-shaped elastic bodies, which are superimposed on each other.

According to this aspect, as described in the second embodiment, by using two sheet-shaped elastic bodies having the same shape and one sheet-shaped elastic body having a different shape from the two sheet-shaped elastic bodies, it is possible to further reduce toner scattering.

Aspect H

In Aspect G, the two sheet-shaped elastic bodies (for example, the second and third elastic sheets **332***b* and **332***j*) having the same shape have a held portion (for example, the interposing portion **3321**) that is held on the nozzle insertion portion (for example, the nozzle receiver **330**) and an end portion (for example, the free end **432**) that is not held, and an entire area of the end portion disposed to overlap another sheet-shaped elastic body to cover the entire nozzle insertion opening (for example, the nozzle insertion opening **331**), and the sheet-shaped elastic body (for example, the first elastic sheet **332***a*) having the different shape has a donut shape that covers a portion other than a central portion of the nozzle insertion opening.

According to this aspect, as described in the second embodiment, by using two sheet-shaped elastic bodies and a donut-shaped sheet-shaped elastic body, the strength (closing force) of the overlapping portion (for example, the overlapping portion **332***c*) of the two sheet-shaped elastic bodies is provided. Due to this, it is possible to further prevent the toner leakage from the container opening (for example, the container opening **33***a*) due to vibration during transportation.

Aspect I

In Aspect G, the two sheet-shaped elastic bodies (for example, the second and third elastic sheets **332***b* and **332***j*) having the same shape have a held portion (for example, the interposing portion **3321**) that is held on the nozzle insertion portion (for example, the nozzle receiver **330**) and an end portion (for example, the free end **432**) that is not held, and an entire area of the end portion disposed to overlap another sheet-shaped elastic body to cover the entire nozzle insertion opening (for example, the nozzle insertion opening **331**), and the sheet-shaped elastic body (for example, the first elastic sheet **332***a*) having the different shape has a shape that covers an entire area of the nozzle insertion opening and has a slit (for example, the first slit **332***f*) provided in a central portion.

According to this aspect, as described in the second embodiment, by using two sheet-shaped elastic bodies and the sheet-shaped elastic body having a slit, the strength (closing force) of the overlapping portion (for example, the overlapping portion **332***c*) of the two sheet-shaped elastic bodies is provided. Due to this, it is possible to further prevent the toner leakage from the container opening (for example, the container opening **33***a*) due to vibration during transportation.

Aspect J

In Aspect A, the elastic sheet member (for example, the elastic sheet **332**) has a through-hole (for example, the first and second round through-holes **332***d* and **332***e*) that passes from one surface thereof to the other surface, and the plurality of elastic sheet members are arranged so that the positions of the respective through-holes do not overlap when the elastic sheet members are superimposed on the nozzle insertion opening (for example, the nozzle insertion opening **331**).

According to this aspect, as described in Examples 2 and 3 of the first embodiment, since the through-holes are shifted from each other, it is possible to seal a through-hole provided in one of the plurality of sheet-shaped elastic bodies with the other sheet-shaped elastic bodies. Moreover, the plurality of sheet-shaped elastic bodies overlaps to seal the surrounding of the through-hole. Due to such a configuration, in a state where the powder conveying nozzle (for example, the conveying nozzle **611**) is not inserted, it is possible to suppress powder (for example, toner) from leaking from the nozzle insertion opening due to vibration during transportation.

Aspect K

In Aspect J, a dimension of the through-hole (for example, the diameter of a round hole of the first and second round through-holes **332***d* and **332***e*) is smaller than a dimension of a cross-section orthogonal to the insertion direction of the powder conveying nozzle (for example, the diameter of the conveying nozzle **611**).

According to this aspect, as described in Example 2 of the first embodiment, when the powder container is detached from the powder conveying device, the powder conveying nozzle is removed from the nozzle insertion opening (for example, the nozzle insertion opening **331**) in a state where

the sheet-shaped elastic body (for example, the elastic sheet **332**) is in contact with the powder conveying nozzle. In this case, the powder conveying nozzle is removed from the nozzle insertion opening in such a manner that the contamination on the surface of the powder conveying nozzle is scraped off by the sheet-shaped elastic body. Since the dimension of the through-hole is smaller than the dimension of the powder conveying nozzle, the scraping-off effect is improved. Due to this, when the powder container is detached from the powder conveying device, it is possible to suppress powder (for example, toner) from leaking from the nozzle insertion opening.

Aspect L

In Aspect A, the elastic sheet member (for example, the elastic sheet **332**) has a slit (for example, the first and second slits **332***f* and **332***g*) that passes from one surface thereof to the other surface, and the plurality of elastic sheet members are arranged so that the positions of the respective slits do not overlap when the elastic sheet members are superimposed on the nozzle insertion opening (for example, the nozzle insertion opening **331**).

According to this aspect, as described in Example 3 of the first embodiment, by forming a slit, it is possible to decrease an opening area as compared to the configuration where a round hole is provided and to suppress toner leakage.

Aspect M

In Aspect L, the slit (for example, the first and second slits **332***f* and **332***g*) has a small-diameter round hole provided at both ends thereof.

According to this aspect, as described in Example 3 of the first embodiment, since a small round hole is provided at both ends of the slit, it is possible to suppress tearing of the sheet-shaped elastic body (for example, the elastic sheet **332**).

Aspect N

In Aspect A, the plurality of sheet-shaped elastic bodies (for example, the elastic sheets **332**) has a held portion (for example, the interposing portion **3321**) that is held on the nozzle insertion portion (for example, the nozzle insertion opening **331**) and an end portion (for example, the free end **432**) that is not held, and an entire area of the end portion disposed to overlap another sheet-shaped elastic body to cover the entire nozzle insertion opening.

According to this aspect, as described in the embodiments, it is possible to realize a configuration in which leakage of a powder (for example, toner) resulting from vibration or dropping during transportation of the powder container (for example, the toner container **32**) can be suppressed.

Aspect O

In Aspect N, a semi-circular notch (for example, the notch **332***h*) is provided in an end portion (for example, the free end **432**).

According to this aspect, as described in Example 4 of the first embodiment, when the front end of the powder conveying nozzle (for example, the sheet member guide **611***a*) comes in contact with the sheet-shaped elastic body (for example, the elastic sheet **332**) and is inserted in the powder container (for example, the toner container **32**), it is possible to allow the powder conveying nozzle to follow along the notch. In this way, the powder conveying nozzle can be smoothly inserted along the notch.

Aspect P

In any one of Aspects A to O, the powder container (for example, the toner container **32**) is attached to the powder conveying device (for example, the toner replenishing device **60**) with a longitudinal direction extending in a horizontal direction and the powder conveying nozzle (for example, the conveying nozzle **611**) is inserted along the longitudinal direction, the powder container further includes a powder conveyor (for example, the spiral projection **302**) that is disposed inside the container body (for example, the container body **33**) so as to convey a powder (for example, toner) from one end side in the longitudinal direction to the other end side, and the nozzle insertion portion (for example, the nozzle receiver **330**) is disposed on the other end side.

According to this aspect, as described in the embodiments, it is possible to convey a powder in the container body toward the nozzle insertion portion and to suppress powder from leaking from the nozzle insertion portion using the elastic sheet member (for example, the elastic sheet member **300**).

Aspect Q

In Aspect P, the container body (for example, the container body **33**) includes a container opening (for example, the container opening **33***a*) on the other end side, and the nozzle insertion portion (for example, the nozzle receiver **330**) is disposed in the container opening.

According to this aspect, as described in the embodiments, it is possible to convey a powder in the container body toward the container opening and to suppress a powder from leaking from the container opening using the elastic sheet member (for example, the elastic sheet member **300**).

Aspect R

In Aspect P or Q, the container body (for example, the container body **33**) has a container gear (for example, the container gear **301**) that can transmit driving power to the powder conveyor (for example, the spiral projection **302**) on the other end side, and the elastic sheet member (for example, the elastic sheet member **300**) is disposed within a range of a gear width of the container gear in the longitudinal direction.

According to this aspect, as described in the second embodiment, such an action that tilts the powder container (for example, the toner container **32**) during power transmission does not occur, and problems such as an increase in the output driving power and generation of noise resulting from the tilt of the powder container can be prevented.

Aspect S

In any one of Aspects P to R, the powder container includes a scooping portion (for example, the scooping portion **304**) that receives powder (for example, toner) from the powder conveyor (for example, the spiral projection **302**), rotates to scoop the powder from a lower side to an upper side in the container body (for example, the container body **33**), and moves the powder to a powder inlet (for example, the nozzle opening **610**) of the powder conveying nozzle (for example, the conveying nozzle **611**).

According to this aspect, as described in the embodiments, such a gap that a powder can pass through is rarely provided as compared to the conventional elastic sheet member in

which the nozzle insertion opening is blocked by one sheet-shaped elastic body. Thus, it is possible to suppress leakage of a powder better than the printer controller including the conventional elastic sheet member.

Aspect T

In Aspect S, the nozzle insertion portion (for example, the nozzle receiver **330**) includes: an extension portion (for example, the extension portion **335***a*) provided so as to extend from a nozzle insertion opening (for example, the nozzle insertion opening **331**) side of the nozzle insertion portion toward an inner side of the container body (for example, the container body **33**); and a void region (for example, the extension-portion opening **335***b*) adjacent to the extension portion, wherein the nozzle insertion portion rotates whereby the extension portion and the void region alternately cross the powder inlet (for example, the nozzle opening **610**).

According to this aspect, as described in the embodiments, it is possible to realize a configuration in which a powder (for example, toner) pumped by the scooping portion (for example, the scooping portion **304**) is supplied to the powder inlet.

Aspect U

An image forming apparatus (for example, the copying machine **500**) including: an image forming unit (for example, the printer unit **100**) that forms an image on an image carrier (for example, the photoreceptor **41**) using an image forming powder (for example, toner); a powder conveyor (for example, the toner replenishing device **60**) that conveys the powder to the image forming unit; and a powder container that is detachably held in the powder conveyor, wherein the powder container (for example, the toner container **32**) according to any one of Aspects A to T is used as the powder container.

According to this aspect, as described in the embodiments, it is possible to suppress the occurrence of contamination inside the device and contamination outside the device when the powder container is replaced.

Aspect A2

A powder container (for example, the toner container **32**) including: a container body (for example, the container body **33**) that stores a powder (for example, toner) to be supplied to a powder conveying device (for example, the toner replenishing device **60**); a nozzle insertion portion (for example, the nozzle receiver **330**) having a nozzle insertion opening (for example, the nozzle insertion opening **331**) through which a powder conveying nozzle (for example, the conveying nozzle **611**) of the powder conveying device is inserted into the container body; an opening blocking member (for example, the elastic sheet **332**) that blocks the nozzle insertion opening in a state where the powder conveying nozzle is not inserted and is elastically deformed to allow the powder conveying nozzle to pass when the powder conveying nozzle is inserted; and a sealing member (for example, the cap **370**) that is attached to the container body in which the powder conveying nozzle is inserted to seal the nozzle insertion opening and is detached from the container body when the powder conveying nozzle is inserted, wherein the sealing member includes a contact portion (for example, the columnar member **373**) that comes in contact with the opening blocking member in a state of being attached to the container body.

According to this aspect, since the contact portion is in contact with the opening blocking member, even when vibration or impact is transmitted to the opening blocking member, it is possible to suppress elastic deformation resulting from the vibration or impact. By suppressing elastic deformation, it is possible to suppress a gap from being provided in a portion of the nozzle insertion opening blocked by the opening blocking member resulting from vibration or impact. Thus, it is possible to suppress a powder in the container body from reaching a space between the sealing member and the opening blocking member in a state where the sealing member is attached. Due to this, it is possible to suppress the leakage of powder when the sealing member is detached from the powder container.

Therefore, it is possible to suppress the leakage of a powder when the sealing member is detached from the powder container.

Aspect B2

In Aspect A2, the contact portion (for example, the columnar member **373**) is formed of a different member from the sealing member (for example, the cap **370**) and is attached to the sealing member.

According to this aspect, as described in the embodiments, since the sealing member is formed of an inexpensive material different from the contact portion while using a material that enhances adhesion to the contact portion, it is possible to reduce the cost while maintaining the powder leakage preventing function of the contact portion.

Aspect C2

In Aspect A2, the contact portion (for example, the columnar portion **374**) is formed integrally with the sealing member (for example, the cap **370**).

According to this aspect, as described in Example 2 of the first embodiment, since the contact portion can be formed (molded) integrally with a portion of the sealing member, it is possible to reduce the cost.

Aspect D2

In any one of Aspects A2 to C2, a portion of the contact portion (for example, the columnar portion **374**) making contact with the opening blocking member (for example, the elastic sheet **332**) is formed of an elastic body (for example, the front end columnar elastic member **375**).

According to this aspect, as described in Example 3 of the first embodiment, the adhesion to the opening blocking member when the elastic body makes contact with the opening blocking member is improved further as compared to the configuration where the elastic body is not provided. Thus, it is possible to prevent the toner leakage resulting from impact due to vibration or dropping more effectively.

Aspect E2

In any one of Aspects A2 to D2, the sealing member (for example, the cap **370**) has an adsorbent (for example, the adsorbent **372**) provided to be open to the outside.

According to this aspect, as described in Example 4 of the first embodiment, it is possible to prevent air or moisture from entering into the powder container (for example, the toner container **32**). Moreover, since the sealing member has the adsorbent, the adsorbent can be removed from the powder

container together with the sealing member by detaching the sealing member when using the powder container, and the operability is improved.

Aspect F2

In any one of Aspects A2 to D2, the sealing member (for example, the cap **370**) has an adsorbent (for example, the adsorbent **372**) provided to be sealed from the outside.

According to this aspect, as described in the second embodiment, it is possible to prevent air or moisture from entering into the powder container (for example, the toner container **32**). Moreover, since the sealing member has the adsorbent, the adsorbent can be removed from the powder container together with the sealing member by detaching the sealing member when using the powder container, and the operability is improved. Further, since it is possible to adsorb gas generated by the powder itself, the adsorbing performance is improved as compared to the configuration of Aspect E2. Moreover, since the powder storage space is sealed and the adsorbent is provided in this sealed space, the powder and the adsorbent are not affected by the outside air around the powder container. Thus, a packaging material is not required.

Aspect G2

In any one of Aspects A2 to F2, the opening blocking member (for example, the elastic sheet **332**) is made up of a plurality of sheet-shaped elastic sheet members attached to the nozzle insertion portion (for example, the nozzle receiver **330**), and the plurality of elastic sheet members overlaps in a portion through which the powder conveying nozzle (for example, the conveying nozzle **611**) passes in a state where the nozzle insertion opening (for example, the nozzle insertion opening **331**) is blocked.

According to this aspect, as described in the embodiments, it is possible to allow the contact portion (for example, the columnar member **373**) to make contact with the opening blocking member so as to slightly enter therein. As a result, tension is applied to the opening blocking member, and adhesion (air-tightness) of the plurality of elastic sheet members (for example, the elastic sheets **332**) in the overlapping portion is improved. Thus, it is possible to prevent toner leakage more effectively, and satisfactory characteristics against vibration and impact are obtained.

Aspect H2

In any one of Aspects A2 to G2, the container body is formed of a container body (for example, the container body **33**) that rotates to convey a powder (for example, toner) stored therein from one end side (for example, the container rear end side) in a rotation axis direction to the other end side (for example, the container front end side) on which an opening (for example, the container opening **33***a*) is provided, the nozzle insertion portion (for example, the nozzle receiver **330**) is provided in the opening, an end surface on the other end side of the container body protrudes in the rotation axis direction further than the end surface on the other end side of the nozzle insertion portion on which the nozzle insertion opening (for example, the nozzle insertion opening **331**) is open, and the contact portion (for example, the columnar member **373**) is a columnar portion that extends from a body portion of the sealing member located closer to the other end side than the end surface on the other end side of the container body to a position where the columnar portion makes contact with the opening blocking member (for example, the elastic sheet **332**) in a state where the sealing member (for example, the cap **370**) is attached to the container body.

According to this aspect, as described in the embodiments, the end surface on the other end side of the container body against which the body of the sealing member bumps protrudes in the rotation axis direction further than the end surface on the other end side on which the nozzle insertion opening of the nozzle insertion portion is open. In such a configuration, although there is a certain distance between the body of the sealing member and the opening blocking member, since the contact portion is a columnar portion that extends by this distance, it is possible to allow the contact portion to make contact with the opening blocking member. Therefore, it is possible to suppress leakage of a powder when the sealing member is detached from the powder container.

Aspect I2

An image forming apparatus (for example, the copying machine **500**) including: a toner image forming means (for example, the printer unit **100**) that forms a toner image using toner which is powder; and a toner conveying device (for example, the toner replenishing device **60**) that conveys the toner from a toner container which is a container body (for example, the toner container **32**) to the toner image forming means, wherein the powder container according to any one of Aspects A2 to H2 is used as the powder container.

According to this aspect, as described in the embodiments, it is possible to suppress the occurrence of contamination inside the device and contamination outside the device when the powder container is replaced.

The present embodiment includes inventions according to the following aspects.

Aspect J2

A powder container including: a container body that is attached to a powder conveying device with a longitudinal direction extending in a horizontal direction so as to store image forming powder to be supplied to the powder conveying device; a powder conveyor disposed inside the container body so as to convey the powder from one end side in the longitudinal direction to the other end side where a container opening is provided; a nozzle insertion portion that is disposed in the container opening and that has a nozzle insertion opening through which a powder conveying nozzle of the powder conveying device is inserted in the container body; and a scooping portion that receives the powder from the powder conveyor, rotates to scoop the powder from a lower side of the container body to an upper side, and moves the powder to a powder inlet of the powder conveying nozzle, wherein the nozzle insertion portion includes: an opening blocking member that blocks the nozzle insertion opening in a state where the powder conveying nozzle is not inserted and is deformed to allow the powder conveying nozzle to pass when the powder conveying nozzle is inserted; an extension portion provided so as to extend from a nozzle insertion opening side of the nozzle insertion portion toward an inner side of the container body; and a void region adjacent to the extension portion, and the nozzle insertion portion rotates whereby the extension portion and the void region alternately cross the powder inlet.

In the invention according to Aspect J2, in a state where toner is sufficient in the container body **33** as the container body, for example, immediately after the toner container **32** as the powder container is attached to the toner replenishing

device **60** as the powder conveying device, an overflowably large amount of toner is continuously supplied to the nozzle opening **610** as the powder inlet of the conveying nozzle **611** as the powder conveying nozzle. Thus, the extension portion **335***a* is rotated to cross above the nozzle opening **610** to drop the overflowing toner, and the conveying screw **614** in the conveying nozzle **611** is controlled to rotate intermittently. In this way, it is possible to replenish a desired amount of toner to the developing device **50**.

Aspect K2

In the powder container according to Aspect J2, at least an outer circumferential surface of the extension portion is a relaying portion that moves powder from the scooping portion to the powder inlet.

In the invention according to Aspect K2, even when the amount of toner in the container body **33** as the container body decreases, the replenishing speed is stable and the amount of toner remaining in the container body **33** during replacement of the toner container **32** as the powder container can be reduced. Moreover, since the amount of toner remaining in the container body **33** during replacement can be reduced, it is possible to reduce a running cost, improve cost performance, and reduce the amount of wasted toner to reduce an adverse effect on environment.

Aspect L2

In the powder container according to Aspect K2, the scooping portion and the relaying portion rotate in the same direction, and are disposed to be adjacent to each other so that an end in the circumferential direction of the extension portion and a convex portion of the scooping portion bulging toward the inner side of the container body appear in that order from a downstream side to an upstream side in the rotation direction.

The invention according to Aspect L2 is a specific layout that enables the extension portion **335***a* to function as the relaying portion.

Aspect M2

In the powder container according to Aspect J2, the container body has a longitudinal direction extending in a rotation axis when conveying a powder and is held in the powder conveying device so as to be rotatable in relation to the powder conveying nozzle, the nozzle insertion portion is attached to the container body, and the scooping portion includes a convex portion in which an inner wall surface of the container body bulges toward the inner side of the container body and a bulging inner wall surface that is connected from the convex portion to an inner circumferential surface of the container body.

The invention according to Aspect M2 relates to a specific shape of the scooping portion.

Aspect N2

In the powder container according to Aspect. J2 or K2, the container body has a longitudinal direction extending in a rotation axis when conveying powder and is held in the powder conveying device so as to be rotatable in relation to the powder conveying nozzle, the nozzle insertion portion is attached to the container body, the scooping portion includes a convex portion in which an inner wall surface of the container body bulges toward the inner side of the container body and a bulging inner wall surface that is connected from the convex portion to an inner circumferential surface of the container body, and the convex portion and the relaying portion are in close contact or face each other with a small gap.

The invention according to Aspect N2 can contribute to improving mass productivity by taking the dimensional accuracy upon manufacturing into consideration.

According to an embodiment, a plurality of elastic sheet members are arranged so as to overlap at least partially. Even when a gap through which powder can pass is provided in one elastic sheet member, it is possible to prevent powder from leaking if another elastic sheet member blocks a passage of the powder. Thus, it is possible to suppress leakage of powder better than a powder container having the conventional elastic sheet member in which a slit is provided in one elastic sheet member.

Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

REFERENCE SIGNS LIST

26: Sheet feeding tray
27: Sheet feeding roller
28: Registration roller pair
29: Sheet discharging roller pair
30: Stacking portion
32: Toner container
33: Container body
33*a*: Container opening
34: Container front end cover
34*a*: Gear exposing opening
34*b*: Color identifying rib
41: Photoreceptor
42*a*: Cleaning blade
42: Photoreceptor cleaning device
44: Charging roller
46: Image forming unit
47: Exposure device
48: Intermediate transfer belt
49: Primary transfer bias roller
50: Developing device
51: Developing roller
52: Doctor blade
53: First developer accommodating portion
54: Second developer accommodating portion
55: Developer conveying screw
56: Toner density detection sensor
60: Toner replenishing device
64: Falling path defining portion
70: Toner container receiving portion
71: Insertion opening defining portion
72: Container receiving portion
73: Cap portion
82: Secondary transfer backup roller
85: Intermediate transfer unit
86: Fixing device
89: Secondary transfer roller
90: Controller
91: Container rotation driving unit
100: Printer unit
200: Sheet feeding unit
301: Container gear
302: Spiral projection

303: Knob
304: Scooping portion
304*a*: Scooping spiral projection
304*f*: Scooping wall surface
304*h*: Convex portion
305: Front end opening
306: Cover hook stopper
330: Nozzle receiver
331: Nozzle insertion opening
332: Elastic sheet (opening blocking member)
332*a*: First elastic sheet
332*b*: Second elastic sheet
332*c*: Sheet overlapping portion
332*d*: First round through-hole
332*e*: Second round through-hole
332*f*: First slit
332*g*: Second slit
332*h*: Notch
332*j*: Third elastic sheet
332*k*: Third round through-hole
332*p*: Nozzle contact position
333: Container seal
335: Sheet stopper
335*a*: Extension portion
335*b*: Extension-portion opening
335*c*: Extension-portion downstream end surface
336: Container seal attached wall
337: Attaching portion of nozzle receiver
337*a*: Nozzle shutter bumping rib
339: Container engaged portion
339*a*: Guide projection
339*b*: Guide groove
339*c*: Step portion
339*d*: Engaged opening
341: Cover claw portion
361: Slide guide
361*a*: Slide groove
370: Cap
371: Cap flange portion
400: Scanner unit
372: Adsorbent
373: Columnar member
373*a*: Front-end-side columnar portion
373*b*: Base-end-side columnar portion
374: Columnar portion
374*a*: Front-end-side columnar portion
374*b*: Base-end-side columnar portion
374*c*: Adsorbing hole
375: Front end columnar elastic member
432: Free end
500: Copying machine
601: Container driving output gear
602: Frame
603: Driving motor
603*a*: Worm gear
604: Power transmission gear
605: Conveying screw gear
607: Nozzle holder
608: Set cover
609: Replenishing device-side locking member
610: Nozzle opening
611: Conveying nozzle
611*a*: Sheet member guide (Nozzle front end)
611*b*: Nozzle-front-end-side inner wall surface
611*s*: Nozzle-opening transversal edge
612: Nozzle shutter
612*a*: Nozzle shutter flange portion
612*b*: First shutter inner circumference rib
612*c*: Second shutter inner circumference rib
612*d*: Third shutter inner circumference rib
612*e*: Nozzle shutter cylinder portion
612*f*: Nozzle shutter spring receiving surface
612*g*: First inner-circumference-rib front end
612*h*: Nozzle shutter sealing member
612*j*: Nozzle shutter seal receiving portion
613: Nozzle shutter spring
614: Conveying screw
615*a*: Container-setting-portion inner circumferential surface
615*b*: Container-setting-portion end surface
615: Container setting portion
640: Oscillating spring
700: IC tag
800: Connector
G: Developer
L: Laser beam
P: Recording medium
T: Toner

The invention claimed is:

1. A powder container comprising:

a container body to store powder to be supplied to a powder conveying device;

a nozzle receiver including a nozzle insertion opening through which a powder conveying nozzle of the powder conveying device is inserted into the container body; and

an elastic cover including a plurality of sheet-shaped elastic bodies, each of the plurality of sheet-shaped elastic bodies extending along a substantially same plane which is perpendicular to an insertion direction of the powder conveying nozzle,

wherein:

the elastic cover blocks the nozzle insertion opening in a state where the powder conveying nozzle is not inserted, and is elastically deformed when the powder conveying nozzle passes through a blocked portion of the nozzle insertion opening, and

at least a part of the plurality of elastic bodies is disposed so as to overlap relative to the insertion direction of the powder conveying nozzle,

wherein each of the sheet-shaped elastic bodies has a held portion that is held on the nozzle receiver and an end portion that is not held such that an entire area of the end portion is covered by the elastic cover when there is no powder conveying nozzle passing through the elastic cover.

2. The powder container according to claim **1**, wherein:

the elastic cover includes three sheet-shaped elastic bodies,

the three sheet-shaped elastic bodies have a same shape, and

the three sheet-shaped elastic bodies are arranged so that an end portion of one sheet-shaped elastic body is disposed at an angle of approximately 120° in a clockwise or counter-clockwise direction relative to an end portion of another sheet-shaped elastic body as a reference.

3. The powder container according to claim **1**, wherein:

the elastic cover includes three sheet-shaped elastic bodies,

the three sheet-shaped elastic bodies have a same shape, and

the three sheet-shaped elastic bodies are arranged so that an end portion of one sheet-shaped elastic body is disposed at an angle of approximately 180° in a clockwise or counterclockwise direction relative to an end portion of an other sheet-shaped elastic bodies as a reference, and an end portion of the other sheet-shaped elastic body is

disposed at an angle of approximately 90° in a clockwise or counter-clockwise direction relative to the reference.

4. The powder container according to claim **1**, wherein:

the elastic cover includes three sheet-shaped elastic bodies,

the three sheet-shaped elastic bodies have a same shape, and

the three sheet-shaped elastic bodies are arranged so that an end portion of one sheet-shaped elastic body is disposed at an angle of approximately 180° in a clockwise or counterclockwise direction relative to an end portion of an other sheet-shaped elastic body as a reference, and an end portion of the one sheet-shaped elastic body is disposed to overlap the end portion of the other sheet-shaped elastic body serving as the reference.

5. The powder container according to claim **1**, wherein:

the elastic cover includes three sheet-shaped elastic bodies, and

the elastic cover includes two sheet-shaped elastic bodies having a same shape and a sheet-shaped elastic body having a different shape from the two sheet-shaped elastic bodies, which are superimposed on each other.

6. The powder container according to claim **5**, wherein:

the sheet-shaped elastic body having the different shape has a donut shape that covers a portion other than a central portion of the nozzle insertion opening.

7. The powder container according to claim **5**, wherein

the sheet-shaped elastic body having the different shape has a shape that covers an entire area of the nozzle insertion opening and has a slit provided in a central portion.

8. The powder container according to claim **7**, wherein

each of the sheet-shaped elastic bodies has a semi-circular notch in an end portion thereof that covers the nozzle insertion opening.

9. The powder container according to claim **1**, wherein

each of the sheet-shaped elastic bodies has a through-hole as the end portion that passes from one surface thereof to the other surface, and

the sheet-shaped elastic bodies are disposed so that the positions of the respective through-holes do not overlap in a state where the sheet-shaped elastic bodies are superimposed on the nozzle insertion opening.

10. The powder container according to claim **9**, wherein

a dimension of the through-hole is smaller than a dimension of a cross-section orthogonal to the insertion direction of the powder conveying nozzle.

11. The powder container according to claim **1**, the powder container is attached to the powder conveying device with a longitudinal direction set as a horizontal direction and the powder conveying nozzle is inserted along the longitudinal direction, the powder container further comprising:

a powder conveyor disposed inside the container body so as to convey a powder from one end side in the longitudinal direction to the other end side,

wherein:

the nozzle receiver is disposed on the other end side,

the container body includes a container opening on the other end side, and

the nozzle receiver is disposed in the container opening.

12. The powder container according to claim **11**, wherein

the container body has a container gear that can transmit driving power to the powder conveyor on the other end side, and

the elastic cover is disposed within a plane which is within a gear width of the container gear in the longitudinal direction.

13. The powder container according to claim **11**, further comprising:

a scooping portion to scoop up the powder from a lower side to an upper side by rotation, and moves the powder in the container body to a powder inlet of the powder conveying nozzle.

14. The powder container according to claim **13**, wherein the nozzle receiver includes:

an extension portion provided so as to extend from a nozzle insertion opening side of the nozzle receiver toward an inner side of the container body; and

a void region adjacent to the extension portion,

wherein the nozzle receiver rotates so that the extension portion and the void region alternately cross the powder inlet.

15. An image forming apparatus comprising:

an image forming unit that forms an image on an image carrier using an image forming powder;

a powder replenishing device that conveys the powder to the image forming unit; and

the powder container according to claim **1** is used as the powder container, the powder container being detachably held in the powder replenishing device.

16. The powder container according to claim **1**, further comprising:

a cap to cover the nozzle insertion opening at outer side of the powder container, the cap being attached to the powder container when not in use,

wherein the cap includes a contact portion that makes contact with the elastic cover in a state where the elastic cover is attached to a container opening.

17. The powder container according to claim **16**, wherein:

the contact portion is to apply a tension to an overlapping portion where the end portion of the sheet-shaped elastic bodies overlap each other, when the cap is attached to the powder container.

18. The powder container according to claim **1**, wherein

the powder container stores toner as the powder.

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